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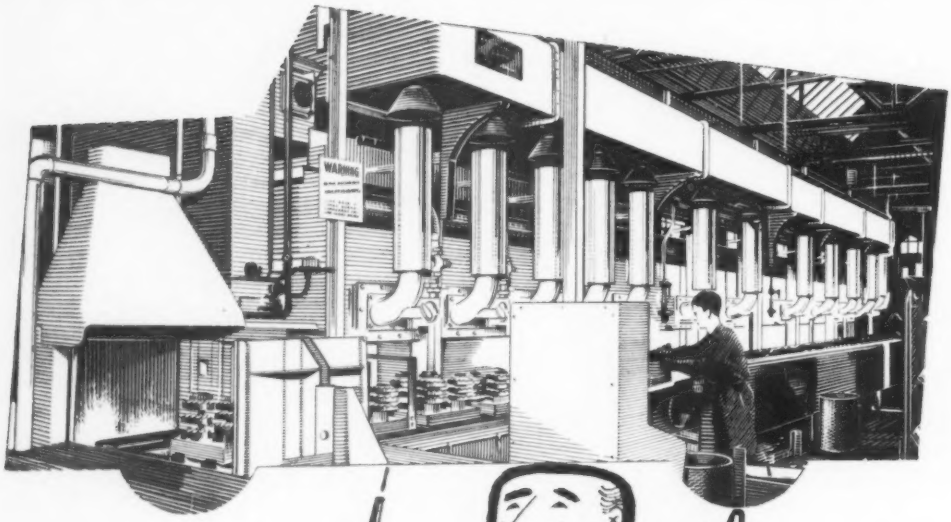

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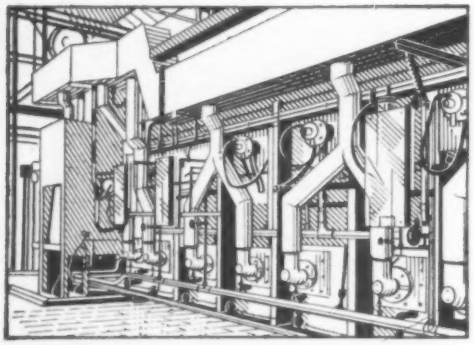

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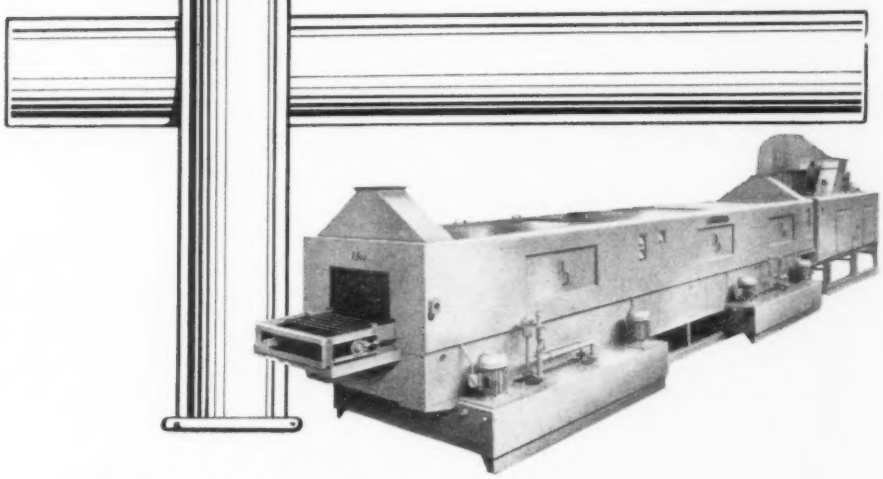

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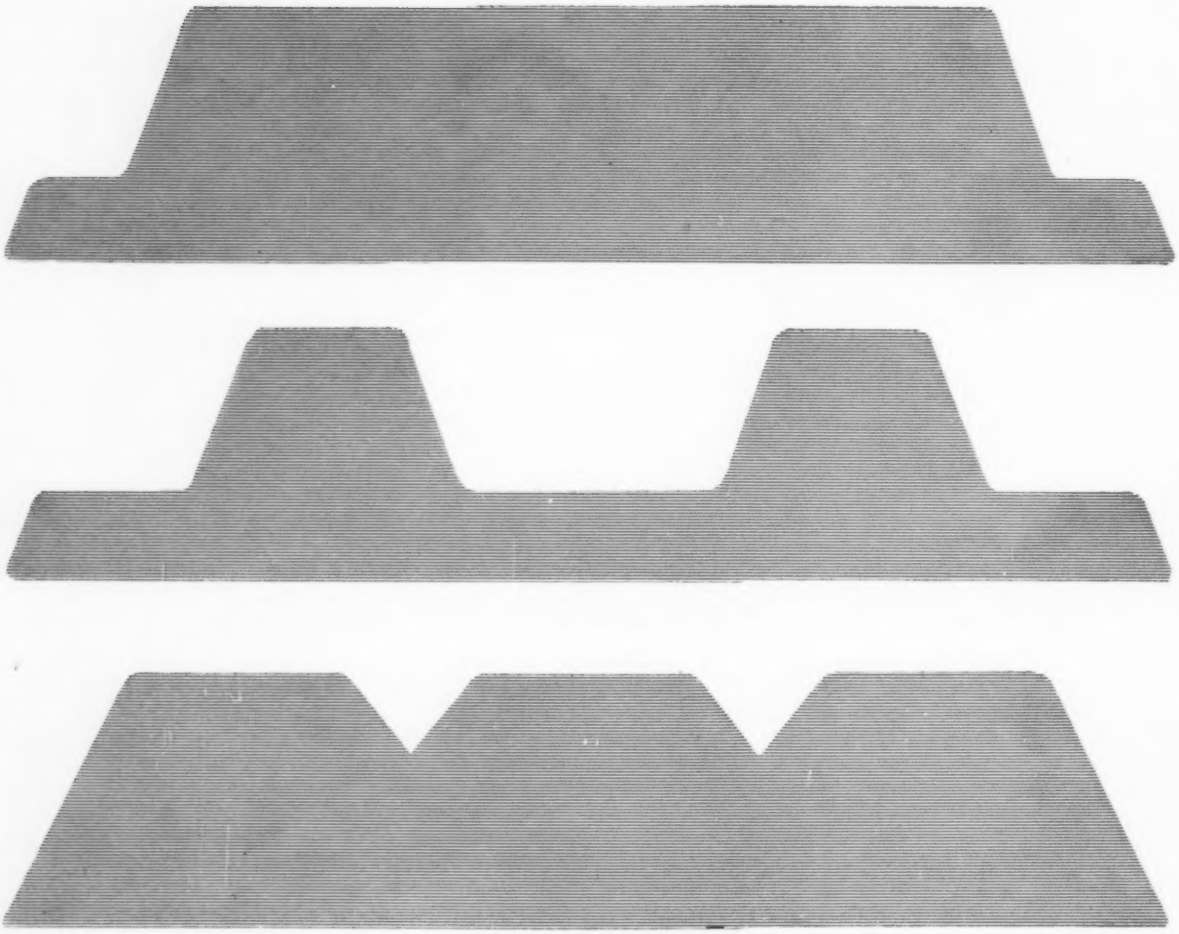

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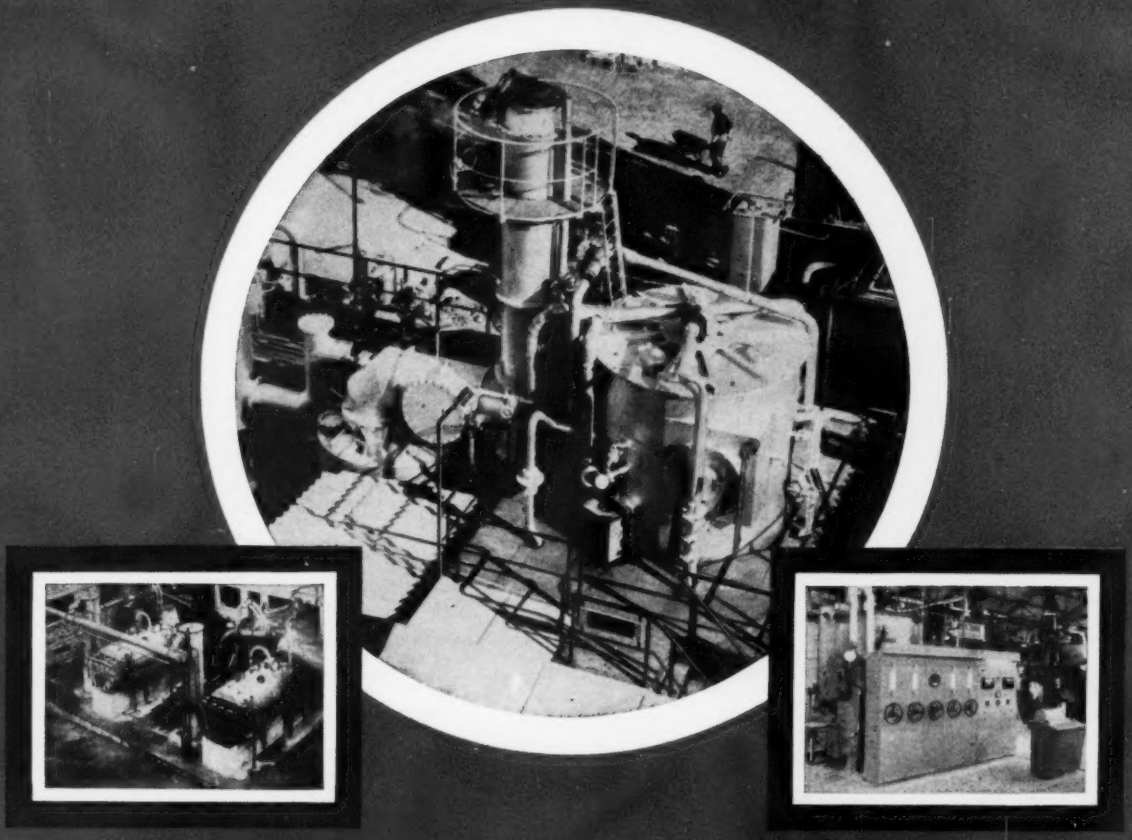

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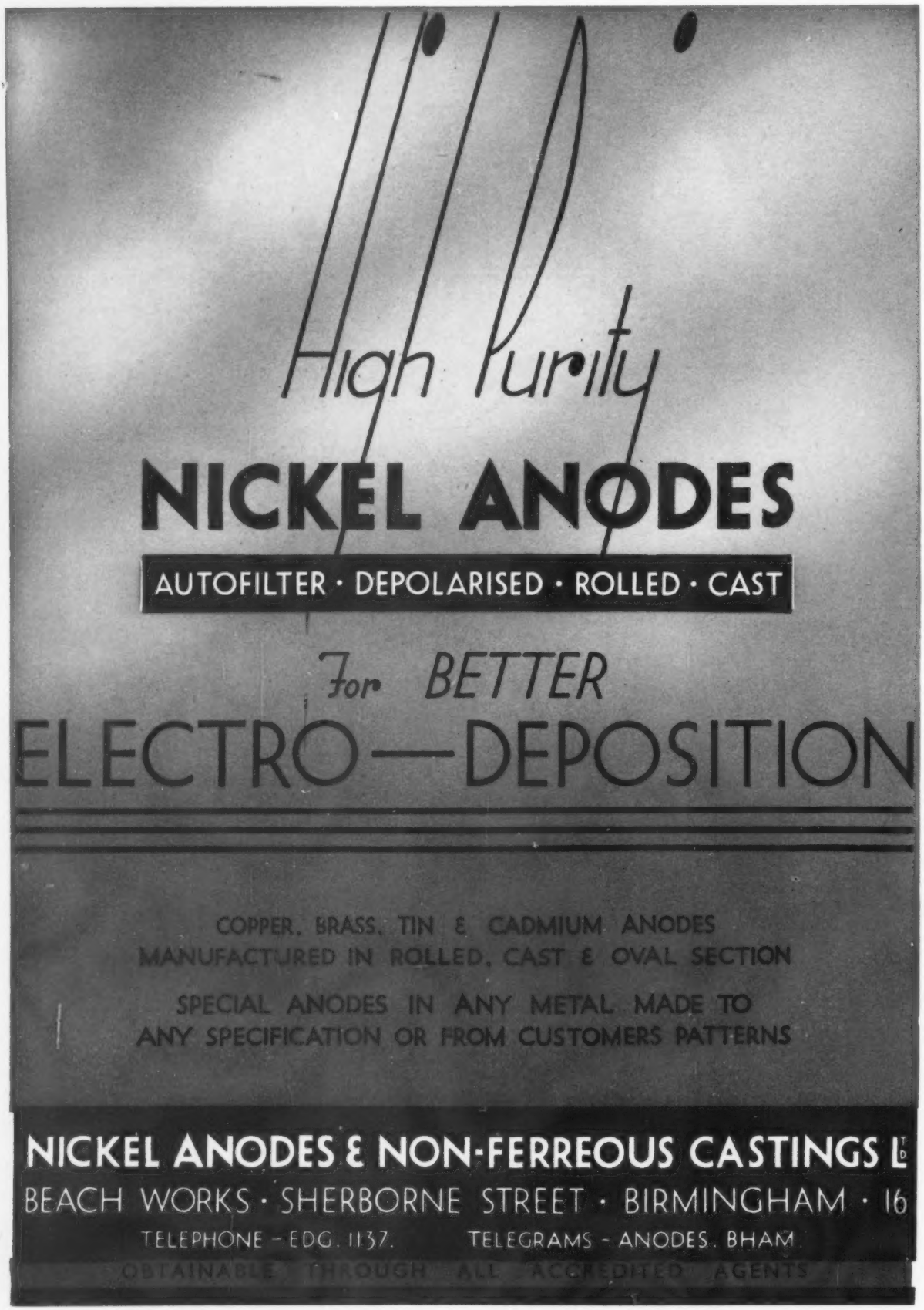
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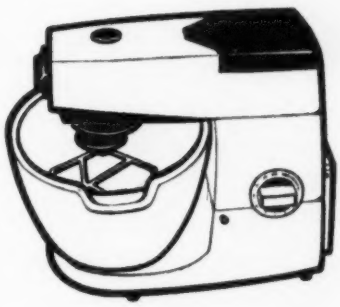

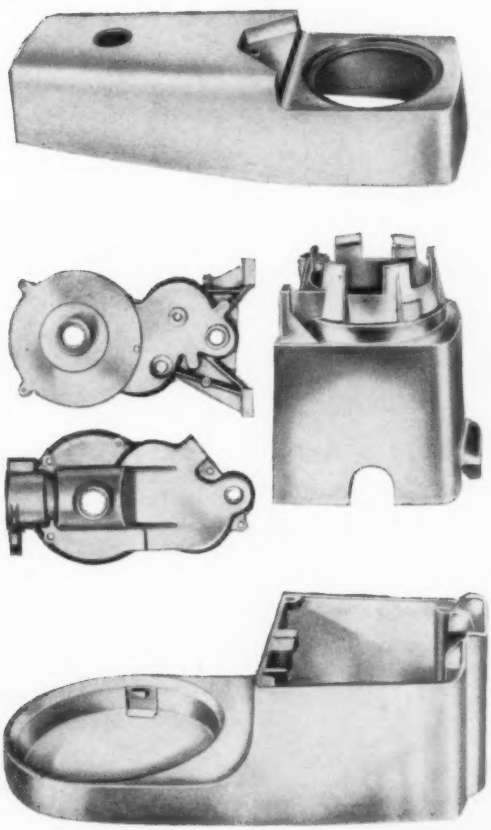

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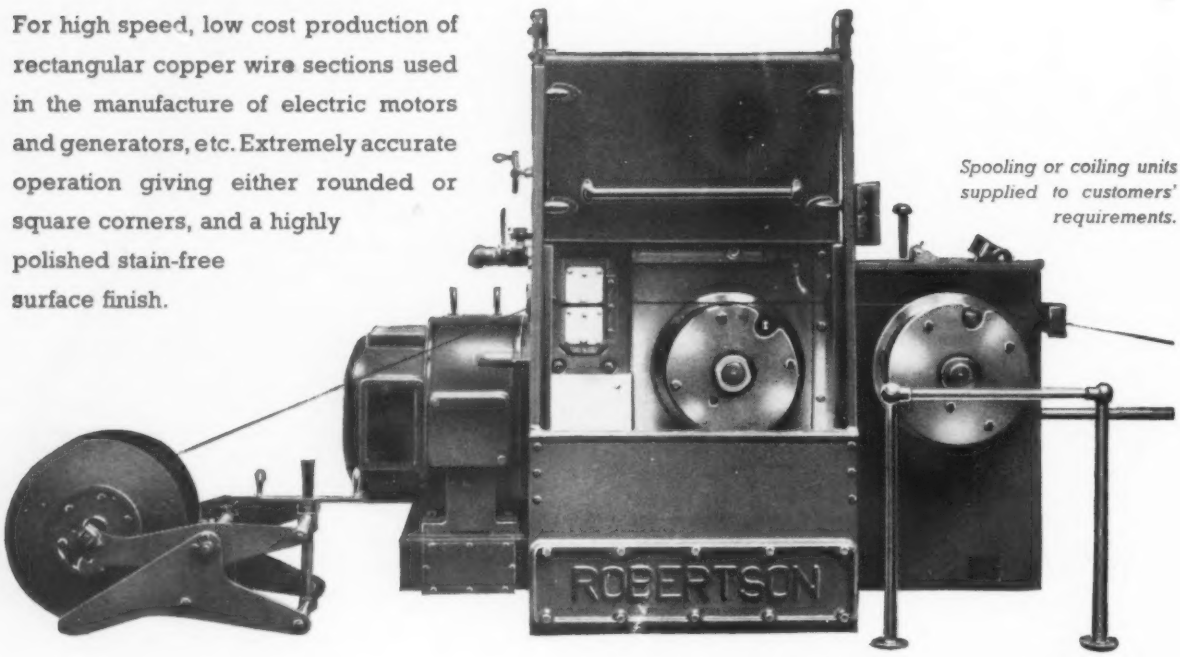

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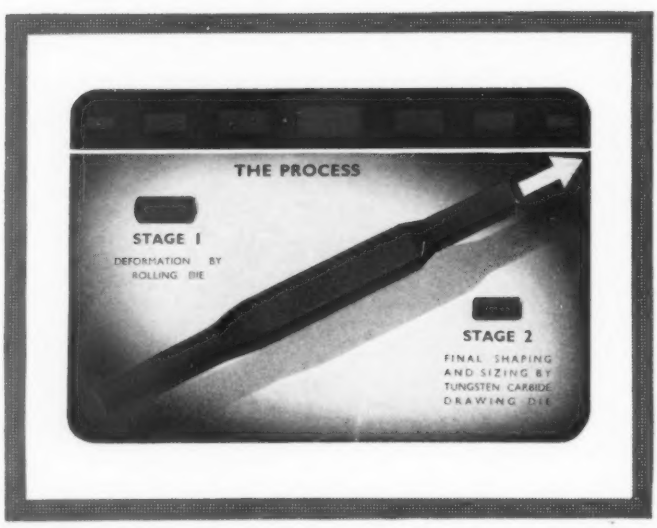

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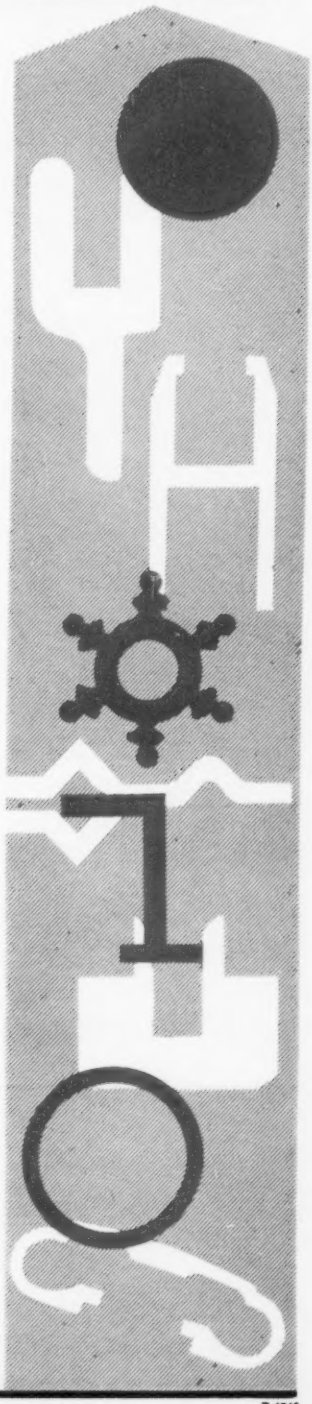

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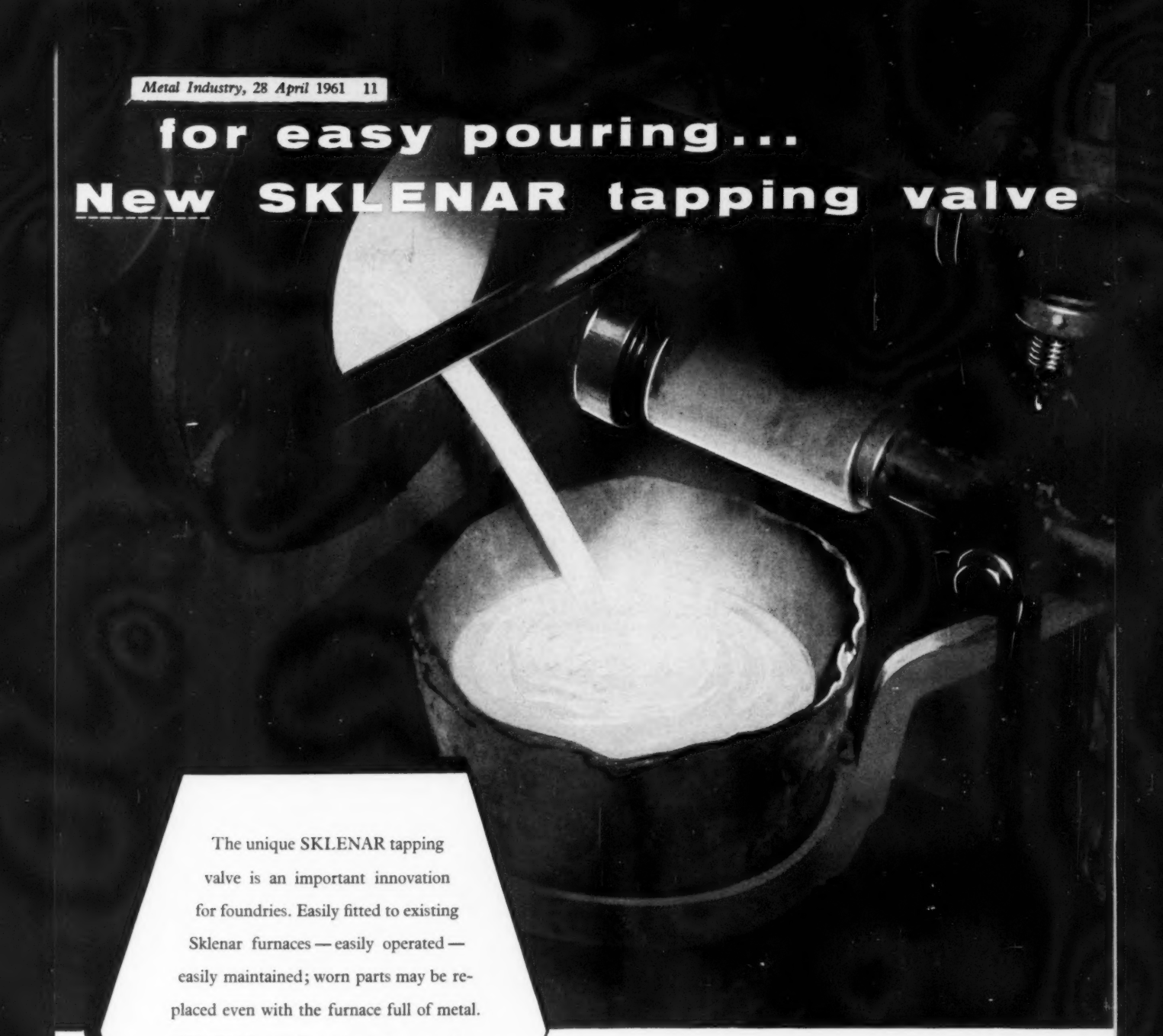

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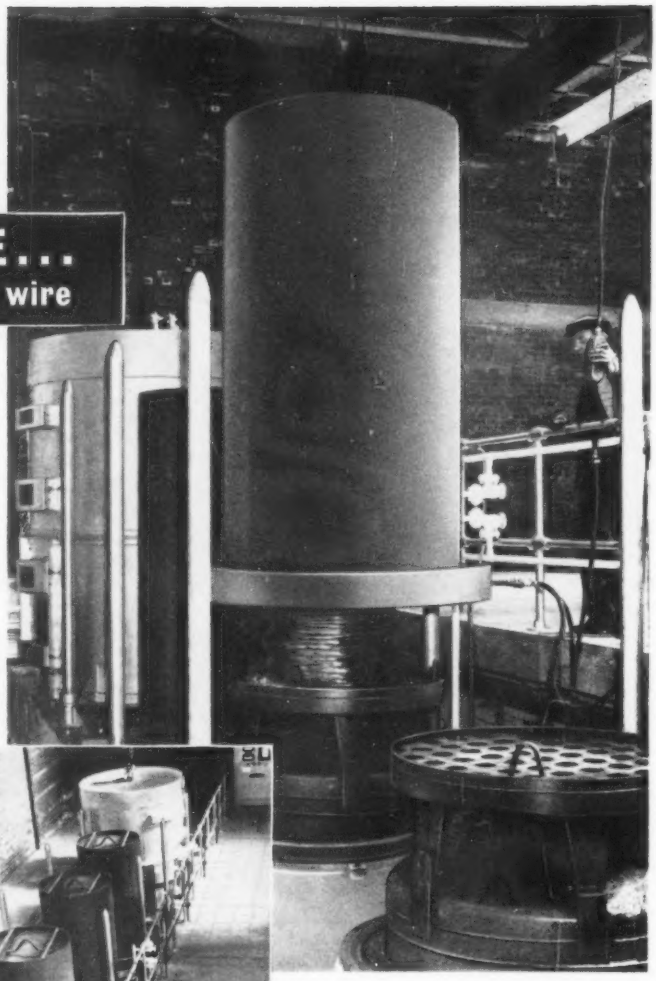

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28 APRIL 1961 VOLUME 98 NUMBER 17

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METAL INDUSTRY

VOLUME 98 NUMBER 17 28 APRIL 1961

Problem of Communication

FROM recent surveys of individual industries some are inclined to think that this country has passed its peak of achievement—a view which we do not share. It is, however, questionable whether we are using to the fullest advantage the vast resources we undoubtedly possess to wage the economic war precipitated by world events. Increasing attention to technological training, greater investment in research and improvements in human relations are examples of only a few fields in which intensified efforts are being made to maintain and improve our position, but the basis on which our future success rests is the use of a complicated network of communications between scientists, technologists, managements, educationists and many other sections of our society. Recognizing this, the Department of Scientific and Industrial Research organized a conference to discuss the problems of communication which confront us; and many themes, some old, some new, were discussed. All were relevant to those engaged in the metallurgical industries.

Many examples were given of the way in which neglect of the written word and personal contact has hindered the assimilation and practical application of knowledge. The ability to write plain English and practise clear thinking should be developed in our schools, colleges and universities. Increased attention to report writing should be given by research workers to enable production technologists to apply the results of their work. The desirability of interesting the non-scientist through the lay Press received support on the grounds that public opinion is a powerful factor in directing our Parliamentary representative's attention to the right order of priorities. Greater freedom of movement of individuals to stimulate discussion through personal contact received full support, and tribute was paid to the value of the work done through the technical liaison services of our research associations. It was significant that the majority of delegates represented our larger industrial units and organizations whereas the greatest need for improved communications probably exists in the medium and smaller units. Other means of communication were considered. Industrial films, exhibitions and conferences have to be accorded their rightful place in the network, and the wide public available through the media of radio and television should not be neglected. The problems facing technical librarians in dealing with the ever-increasing volume of information have yet to be resolved.

The conference served the purpose of bringing together the many aspects of communication which hitherto have received individual attention and what would now appear to be needed is a co-ordinating body to direct the battle and provide support for the inevitable increase in expenditure required to speed-up communications. The possibility of the D.S.I.R. acting in this capacity was suggested. We should not complain that we have a battle on our hands—but be thankful that it is being fought with economic weapons and not weapons of destruction. Nevertheless, to lose would be just as disastrous to our standards of living and freedom.

Out of the MELTING POT

Unclassified

INVENTIONS can be classified broadly into two groups, according to the immediate reaction on the occasion of one's first encounter with them. The reaction in both cases is one of surprise, in the first case at the fact of the invention having been made at all, in the second, at the fact of the invention not having been made earlier. Depending as they do on background knowledge and experience, both types of reaction are inevitably subjective to a greater or lesser degree and are always open to complete dismissal following the application of more knowledge and greater experience that might show that an invention in question is not even novel. Such are the thoughts that arise on learning, for example, of an invention relating to a process for etching a multiplicity of small geometrically arranged pits in a chromium coating to improve the oil-retaining properties of the latter, the process depending on the use of a photo-resist material which is applied to the cleaned and suitably prepared chromium plated surface. The surface coated with the photo-resist material is exposed to light through a half-tone screen or negative which is placed in close contact with the surface. The screen used can have from 30 to 300 lines/in., depending on the application of the surface being treated and the porosity it is desired to obtain. For example, a screen with 300 lines/in. can be used for treating chromium plated cylinder bores, a screen with 30 lines/in. for die blocks, a screen with 32 lines/in. on bearings, and one with 85 lines/in. on clutch plates. After exposure to light, the photo-resist coating is developed. This results in the removal of portions of the coating which were masked by the negative during exposure to light. The remaining coating is heated to render it completely insoluble, and the surface is then etched by immersing in concentrated hydrochloric acid. The depth of the pits etched into the chromium can range from about 0·0002 to 0·002 in. After etching, the surface is rinsed and the photo-resist layer is removed by dissolving in an organic solvent. Now why wasn't this process invented earlier?

Exposed

WHEREVER and whenever information is discovered that is worth communicating, ways and means of doing so will sooner or later be provided. This happens with inventions that, on the one hand, are available for licensing and, on the other, are being sought by manufacturers with a view to using them to extend and diversify established lines and activities. In respect of both, channels of communication have of late been greatly improved. The communications that are conveyed through them, like all other communications nowadays, inevitably suffer from the consequences of the vast sum total of communications. Nevertheless, their existence should reduce the validity of pleas of ignorance as an excuse in regard to both the supply of, and demand for, inventions. The provision of these channels of communication in this particular field has, however, done more than put supply and demand in touch with one another. It has, at the same time, revealed the magnitude of both supply and demand. This aspect merits some attention. In the case of the supply, its size is presumably due to the vigour and spontaneity of the inventive process, the products of which need have no direct connection with demand: hence the subsequent search for one. Further improvements in communications in the direction of inventors might help to orient the latter in the desired directions and thereby simplify the subsequent search for a demand. So far as the demand is concerned, its existence suggests a degree of cluelessness on the part of manufacturers on the lookout for ideas, coupled with some belief in technical and economic miracles. Further improvements in communications directed more particularly at potential inventors, which nowadays includes all students and graduates considering potential research appointments, would serve to strengthen these impressions. This need by no means be undesirable. For one thing it would help in various ways to dispel the lingering impression, and in some cases, alas, more than an impression, of a reactionary resistance to new ideas lurking in the not too distant background.

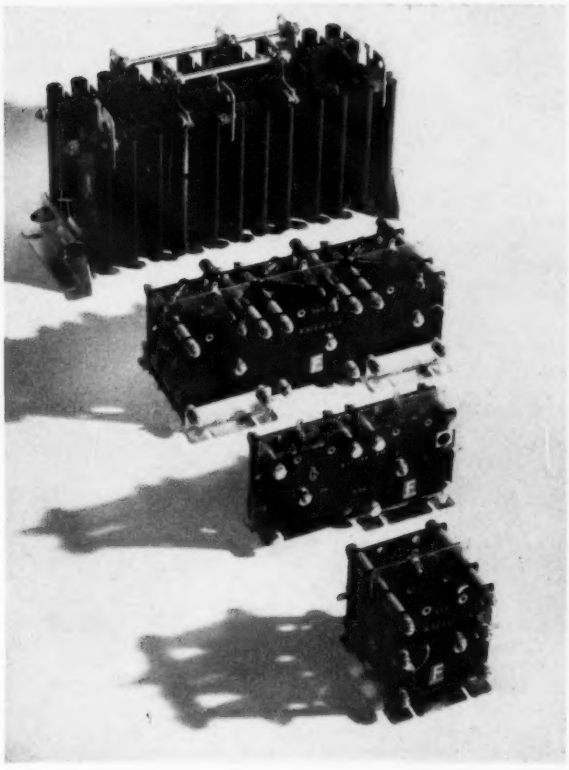
Sandy Lubricant

ANY mention of silica usually calls to mind sand, quartz, flint, and similar hard, gritty and abrasive materials. In view of this firmly ingrained impression, there is no gainsaying the merit of the invention made when it was unexpectedly discovered that dispersions of colloidal silica in liquid carriers make excellent metal cutting and machining fluids. Such fluids not only greatly reduce the amount of heat generated between metal surfaces being worked, but also provide in many instances improved appearance of the finished work. The chips formed are smooth and much cooler than those obtained when using conventional fluids. The nature of the silica to be used is not critical, provided the material is capable of forming colloidal dispersions in a liquid carrier and has an average particle diameter, when dispersed, below about 150 millimicrons. The particles themselves can be either substantially pure silicon dioxide, or they can be modified by the presence of other materials chemically bound to or adsorbed upon their surfaces. A form of substantially pure silica suitable for the purpose in view is so-called fumed silica, obtained by the vapour-phase hydrolysis of a silicon compound. The fluids in which the silica is dispersed can be either water, an organic liquid (e.g. a suitable oil), or an oil-water emulsion. When water is used, corrosion inhibitors can be added, or corrosion can be minimized by adding a soluble alkali to raise the *p*H of the system. The silica concentration in the fluid can vary from 0·01 to 60 per cent, the range between 0·5 and 30 per cent by weight being preferred. The concentration of the silica will be influenced to some extent by the particle size of the material. In general, the greater the particle size, the higher the concentration of silica that can be present without causing gelation of the fluid to a degree that will interfere with the pumping of the fluid in use. Apart from the direct interest in the use of the above colloidal silica preparations as cutting fluids, the excellent results claimed for them should provide an incentive for some fundamental research on the frictional and/or lubricating behaviour of colloidal or near-colloidal dispersions, now that it appears that a lubricating action cannot always be explained on the basis of the layer lattice structure of the dispersed phase as in the case of graphite, molybdenum disulphide, etc.

Skimmer

Metal Finishing for the Electronics Industry

By J. DAWSON, F.I.M.



Power diodes mounted on cooling fins in stocks

Outlining early applications of electrodepositions for the radio industry and following this with a consideration of more recent requirements, this article was originally presented before the North-West Branch of the Institute of Metal Finishing. Major developments in the electronics industry have opened up a variety of new uses for electrodeposited metals, and, correspondingly, have presented a number of new problems to the plater.

UNTIL the late 1920s and early 1930s brought a remarkable increase in the type of radio receivers, little demand had been made commercially by the electronics industry on the finishing industry, except for sundry interesting development projects. One such development which was tried out was the making of a speaker from electrodeposited copper. This was based on the theory that the conventional metal speakers of that time were made by spinning techniques and had a high initial resonance. It was thought that the electro-deposited copper, being relatively free from stresses, might minimize the resonance and thus enable a purer sound form to be produced. The way in which this was done was to make a wax casting of the horn and coat it with conducting graphite, following this by immersing it in copper sulphate solution and sprinkling fine iron powder over the surface of the wax casting below the solution level. This precipitated the copper chemically and when the reaction ceased the wax was removed from the solution and plated in a conventional copper plating bath to a suitable thickness.

The cost of carrying out this operation was very high and it did not prove to be commercially acceptable. In any case, the introduction of the moving coil loudspeaker made a considerable improvement over the existing metal or wooden horn types, and these gradually disappeared. However, it can be considered that this was an early example of the techniques used at the present time, e.g. the manufacture of waveguides for radar, a process to which reference will be made later.

In commercial production, it was possible for some time for the hand-operated plating vats to satisfy the demands of the set and valve makers. With the introduction of manufacture on a much increased scale in the middle of the 1930s, automatic plants for plating chassis valve covers, etc., were put into operation. Cadmium was generally used since this was a metal which was very easy to solder and enabled the various earth contacts to be made with the minimum of difficulty. At the same time, it provided good protection for the underlying steel and, apart from fingermarking, was very satisfactory.

At this date, the cadmium was very dull and had what has been described as a whitewash finish. No appreciable improvement in the character of the deposit took place for several years, although successful attempts were made to make it semi-bright by dipping in dilute nitric acid as one of the final operations. Additions of dextrines and similar compounds to the bath were tried, with varying success.

Due to the high cost of cadmium at this time, some radio manufacturers used zinc plating and yet others Bonderized and painted the chassis. It was very difficult to solder to the zinc and impossible to attach wires to the painted chassis. Special earth contacts were thus necessary, which were lifted up as tags from the main chassis and covered up during plating or painting so that they could be ultimately tinned. Mild type fluxes were used which could be removed by aqueous or organic solvents prior to mounting the various components on the chassis.

Alternatively, these tags were hot-tinned and then covered with suitable stopping-off material prior to plating and/or painting.

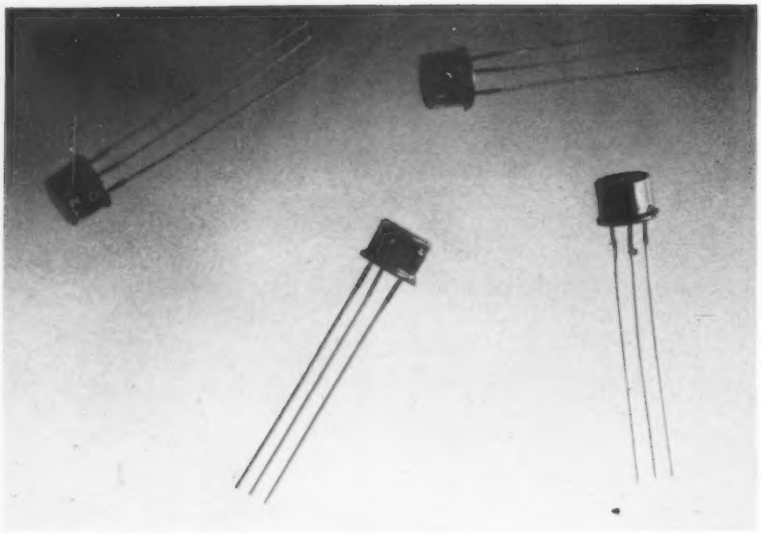
After plating or painting, the stopping-off material was removed and the earth contacts could then be soldered readily to the earthing wire or to components. The question of the use of relatively active fluxes will be mentioned later.

As far as fluxes used with cadmium were concerned, it was necessary to see that these were mainly pure resin with a minimum of activator, such as some form of chloride. Later, such fluxes became the subject of a D.T.D. specification and the problem of standardization was simplified.

Problem of Staining

As has already been indicated, one of the difficulties with cadmium plating had been its readiness to fingermark and to be attacked by many organic acids.

As a matter of interest, it is stated in the literature that human perspiration contains a number of amino-acids together with a large proportion of sodium chloride. Its reaction can be



Typical of the wide range of transistors now in use, these are shown here very slightly larger than they actually are

neutral, acid or alkaline, and the composition and the amount can vary considerably during the day, with varying nervous conditions and with individuals. On many occasions operatives have had to be taken off certain types of assembly work due to the corrosive nature of their perspiration.

It has usually been found difficult to introduce appropriate barrier creams to prevent this happening, as the personnel generally are not willing to apply such materials as a regular routine operation. Wearing of gloves has been tried, but this again is not very satisfactory since it is uncomfortable for the workers to have these on all day.

In view of these difficulties, it is necessary to arrange production methods so that a minimum of handling takes place. Where it does take place the effects on the plating are extremely severe and the surface becomes almost black in colour where an impression of a fingerprint is present. Such corrosion usually takes from one to four weeks to develop, depending on the storage conditions.

In the case of radio chassis, where large numbers of components have to be attached, with the consequent handling that this entails, it will be realized that this problem was serious.

Wherever possible, cadmium plated parts which did not require soldered connections were coated with a thin film of an air-drying lacquer before any handling of the parts took place, as it was found that this effectively resisted the various compounds in perspiration and, to a large extent, the effects of acid fumes.

The complete answer to this problem has not yet been found, and it is to be hoped that some other treatment of the surface will be devised or that some alloy plating will be found that is similar in its properties to cadmium, but resistant to fingermarking. Such a finish would be of the utmost value.

Work has been continuing on the improvement in the brightness of cadmium. It was discovered that additions of sulphated castor oil and nickel or cobalt metals in small quantities gave a very bright finish which could be dipped finally in a mixture of hydrogen peroxide and sulphuric acid solutions to give a very attractive appearance.

An alternative finish, which was not so easy to apply on automatic plants, was to use a two-stage process consisting of a dip into a chromic acid-sulphuric acid mixture and bleaching the resulting yellow film by passing through alkali or alkaline hypochlorite. The type of deposit thus produced was slightly more resistant to fingermarking, but it was not sufficiently good to prevent it if much handling took place.

In order to be certain that the surface was protected it was still necessary to lacquer when possible.

It should be mentioned at this point that passivating the cadmium in the usual dichromate-sulphuric acid solution to such specifications as D.T.D.923 assisted in the resistance to corrosion but again was of little benefit from the fingermarking angle. Nevertheless, provided the iridescent colour of the 923 treatment was not an objection, this type of passivation certainly gave the best corrosion protection. It also acted as a help in keying paint where such films were applied.

Alternatives to Cadmium

Many attempts have been made to find alternative materials to cadmium plating, among which are such alloy systems as tin-zinc and tin-cadmium.

One of the difficulties in the initial experiments with tin-zinc was the preferential plating out of tin into recesses, giving rise to areas of corrosion when tested under severe tropical conditions, to which reference is made later. Some of these difficulties may be eliminated by further work on the solutions, in particular the choice of sequestering or complexing agents.

The later form of the solutions mentioned is based in some cases on cyanide-free alkaline solutions with additions of complexing agents, particularly fluoride-fluorosilicate solutions.

It was mentioned earlier that cadmium was readily attacked by organic acids, and this proved to be a difficulty in using this coating on components which were used in a confined space. For example, in instrument cases great care had to be taken to eliminate any compound which gave off fumes of phenol, formic acid, etc. Such fumes attacked the plating and produced a white coating over the surface. Some of the phenol-formaldehyde (or Bakelite) type of moulding materials were very prone to give this effect, as were some of the varnished insulating cambrics. This attack was reduced by lacquering the surface, but it did not completely prevent it taking effect.

Valve Components

Coincident with the development of the chassis-coating came demands and problems from the valve manufacturing units. For example, gold plating was used on grids in valves to reduce secondary emission. A further interesting use of plating was in the manufacture of tungsten spirals for special valve cathodes. These were made by plating tungsten wire continuously with copper to a thickness of 0·005 in., winding the plated wire into a spiral and annealing to set it into shape. The copper was then dissolved away, leaving the tungsten wire ready for use in the valve as a filament or emitter.

Although not classed as metal finishing in the normal sense, there arose a need to coat the anodes of the valves, which were made from thin nickel strip. These were coated with a deposit of carbon produced by heating them in an atmosphere of benzene, which chemically decomposed, producing a film of carbon on the nickel surface. This had the joint effect of increasing the work function of the nickel, and also acting as a heat radiator, both of which effects decreased secondary emission of electrons, normally a very undesirable phenomenon.

Ease of Soldering

As would be expected in radio and similar assemblies, the problem of soldered joints was always a major one. In these days of mass production, it is essential to have the varying manufacturing operations made as easy as possible. This is particularly the case in making joints in, for example, radio or T.V. receivers, where one bad or dry joint, as it is called, would render the whole set inoperative. While, of course, this would be found at the inspection stage and corrected, there was always the possibility of semi-dry

joints which could come adrift in service.

A great deal of trouble was encountered in the early days of radio set manufacture from this cause, due primarily to the poor or thin tin plating on the leads of the various components such as condensers, resistances and chokes. The difficulty was accentuated by the fact that only non-corrosive fluxes could be used to make such joints since, if a more active flux was used, it could lead to corrosion if left on the set. It was, of course, impracticable to remove such flux residues by solvents on a complicated layout and hence the flux had to be relatively inactive if corrosion troubles were to be avoided. It was, therefore, necessary to have all the wires, etc., which were to be joined, as clean as possible.

In order to achieve this condition, it was usual to have the various wires either tin or tin-lead alloy plated, or, alternatively, hot-tin dipped.

By far the greater bulk of the leads were tin plated, and it became essential to investigate the conditions under which a good plating could be obtained and which would maintain its quality under storage conditions not always of the best. It frequently happened that components newly delivered would be very satisfactory but if stored, for example, for one month, would have to be scraped on the surface or hot tinned in solder pots after dipping in relatively active fluxes which could be removed prior to assembly. In either case, production was greatly interrupted and the efficiency of the process lowered.

A considerable amount of research has been directed to this subject by the firms concerned and by various Research Associations. It has been shown that ease of soldering is closely related to the thickness of tin plating and there is some evidence that the type of plating, i.e. whether acid or stannate, also has an influence.

One method of test was to determine the spread of a standard volume of solder on a given surface which was then heated electrically until the solder melted. The extent of the spread was measured by a planimeter.

Some of the results of a very large number of tests carried out give the following tentative conclusions:

(1) Coatings of tin or alloys of lead generally give excellent solderability when not less than 0·0003 in. thick.

(2) Hot-dipped tin coatings are pre-eminent for soldering quality.

(3) Tin plated coatings on brass can give rise to trouble after storage, due to zinc diffusion and subsequent action of atmospheric moisture. A 0·0001 in. thick copper or nickel undercoat beneath electroplated tin or alloy coating prevents this diffusion.

(4) If solderability is the sole criterion, tin alloy coatings have no advantage over pure tin.

It was a practice at one time to heat flow the electrodeposited coating, thus, as it were, converting it to a hot-dipped coating, as this was shown to give slightly improved properties on storage. This applied particularly to copper and on steel or brass there was said to be no advantage.

Service Requirements

At this point it might be helpful to consider the very stringent conditions laid down by the various Armed Services for electronic apparatus ordered by them. This commenced particularly during the last war and, of course, is now more or less standard practice.

The various specifications to which both components and complete sets had to conform did a great deal to promote first class plating. For example, it was frequently specified that the completed sets might be stored under jungle conditions for long periods and yet be expected to function immediately when switched on. Admittedly, some of these more onerous conditions could only be satisfied by hermetically sealed apparatus, but for the rest, the various finishes and products generally had to be of the highest quality.

All this led to more stringent specifications for the finishes generally, and the accelerated corrosion tests to which they had to conform were made more and more severe. It became common for parts to be subjected to many cycles of accelerated tropical test such as R.C.S.11 for which the components under test are heated to 55°C. with a relative humidity of 95 per cent.

These demands on components which had plated parts had the result of improving many of the usual finishes such as cadmium and zinc, and focused attention on the necessity of having a minimum thickness present, particularly in recessed areas, where corrosion might be expected to start. At the same time, the quality of the deposit had to be of a very high grade, and this led to a good deal of development work on improved solutions and methods.

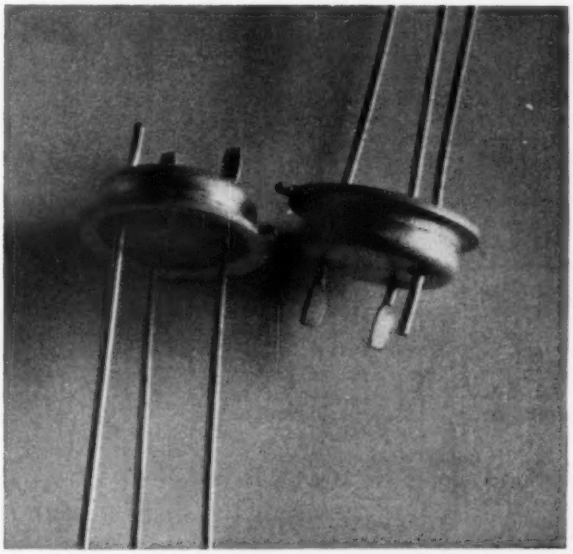
This process of the improvement of plating generally probably started just prior to what can be called the "Electronic Age", i.e. round about 1920, since it was about this time that chromium plating was first introduced into Britain and brought with it a definite need for operational research. It is generally accepted that one of the major improvements in nickel plating largely arose as a result of the ability of chromium plating to strip off any nickel that was not firmly attached to the base metal, due to the high tensile stress in the chromium layer. It became essential to have much improved surface preparation, which had not hitherto been considered necessary. The need for the better adhesion focused attention on the whole subject of cleaning prior to plating, and resulted generally in the old process of brown potash and pumice scrubbing being discontinued. In any case, the advent of automatic plants made it essential to have good automatic cleaning, and research on this aspect has been a major item with many of the trade suppliers.

While the electronics industry has not made any special demands on the plating industry from the point of view of cleaners and detergents, post-plating cleanliness of components is of vital importance and the washing of components after plating sometimes involves many operations. This may include ultrasonic cleaning and boiling in deionized water for relatively long periods.

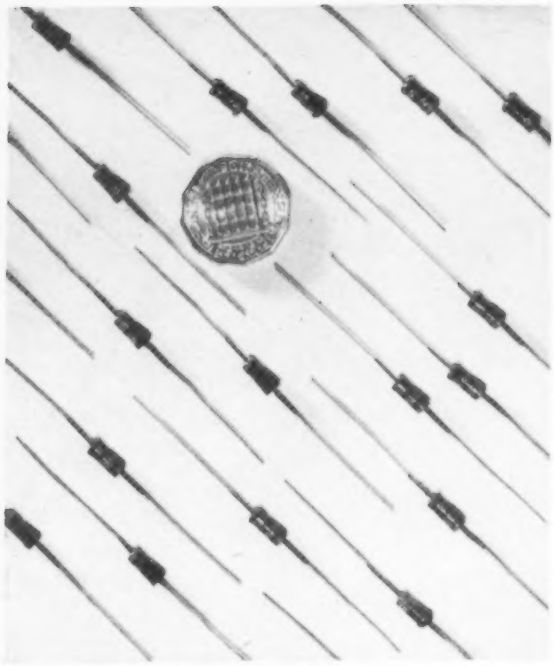
It is essential to make sure that all foreign materials which may be present on the as-plated surface are removed.

Contacts

So far as electrical contacts are concerned, the development of electronic devices made demands on the finishing industry in what was virtually a new field. It was soon realized that the whole subject of contacts was extremely complex and the particular conditions



Gold plated transistor headers



An arrangement of typical diodes with a threepenny piece to indicate their size

in the electronic industry made it more involved.

For example, in the earlier radio sets it was common to use hard phosphor bronze contacts, in some cases plated with either tin, silver or nickel. It is safe to say that anyone having experience of radio sets of those days found extreme difficulty in maintaining good contacts on, say, multipole switches or similar devices. This was so even when the contacts were being continually wiped in operation and, therefore, it is understandable that this condition became worse when the contacts were stationary and not self-cleaning.

Among the various factors contributing to good contact operation can be listed hardness, thermal conductivity, current carried, voltage to be broken, formation of films on the surface, etc. Again, the shape and dimensions are equally important if maximum operating efficiency is to be achieved.

Plating with silver gave slight advantages but, of course, this sulphided on storage and tended to give high contact potentials. Covering or lubricating with a thin film of petroleum jelly or lanolin, applied as a 1 per cent solution in white spirit, gave some slight improvement but was not sufficiently positive.

Precious Metal Deposits

In the consideration of protective metals the choice fell on rhodium, a member of the platinum group of alloys. This has a very high resistance to development of surface films and has a hardness value of about 800-850 V.P.N. The deposit is highly stressed, due possibly to the adsorption of hydrogen during plating or it may be co-deposition of rhodium compounds in minute amounts. Unfortunately, this high internal stress has led to a tendency for the deposit to crack, and this is intensified if the plating exceeds 0·0001 in.

There is some evidence that the underlying deposit of silver has an influence and it may be that some other metal would match the rhodium better and cut down this tendency to crack. Plating at a lower current density with an increase in solution temperature has tended to improve the deposit.

In connection with rhodium, which is a very hard metal as plated, there is the question of hardness versus wear-resistance, as applied to contacts generally. It is well known that extreme hardness on the face of a bearing metal, for example, may not necessarily be the ideal surface, and in some cases a softer and more yielding material may prove to be better. This is also true of contacts, and great care has to be taken to select the right pair of metals for the contacts. It is obvious that this can usually only be determined empirically, and the choice is likely to vary for each type of contact arrangement selected.

The use of gold plating in contacts illustrates this point of hardness. Gold is a relatively soft metal with a hardness as deposited of 60-80 V.P.N. but is, nevertheless, an ideal material for light pressure contacts, in which it may be said to function as a dry, conducting lubricant.

A good deal of work is being devoted to this question of gold-plated contacts, and there have been some interesting developments in alloy gold plating from acid solutions, which can give a hardness of up to 180-200 V.P.N. They are, usually, very smooth and fully bright as plated but again, of course, this increased hardness is not all gain, since the higher stress in the deposit can lead to other troubles. This is particularly true when such types of gold are plated on to printed circuits where the stress can be sufficient to lift off the copper circuit from the laminate.

In passing, mention should be made of the advantage of these acid deposits in printed circuit plating, since the alkaline gold solution can attack the adhesive bonding the copper to the plastic laminate.

Another metal which has been used for contacts with some success is palladium. This is the cheapest of the platinum group of metals, being approximately half the price of gold. The appearance, as deposited, is similar to that of dull nickel, and the hardness is approximately 250 V.P.N. The internal stress in the deposit is very low and the chemical control of the solution is relatively easy.

Although palladium is classified as a member of the platinum group, it tends to form a superficial film on the surface and this, coupled with its rather high electrical resistance, has tended to make its electrical performance inferior to gold.

At present, its use as a contact coating metal is somewhat in doubt, but investigations which are now proceeding may make it possible to utilize its desirable properties.

Another interesting development in the precious metals field, as applied to contacts, is in the use of solid material on one side of the circuit and a plated one on the other, or it is even possible to use solid contacts on both sides.

There are many alloys which are now being used for such solid contacts, the most useful being those containing platinum, gold, silver and copper. Such alloys are virtually untarnishable, and the hardness can be varied to suit individual cases, which allows some flexibility in the choice of the plated contact with which it may have to work.

The objection of high cost has been minimized to a large extent by the use of duplex material where a strip of the precious metal is rolled side by side with a phosphor bronze strip. In this way, the precious metal strip can be on one side of the bronze or it can be in the middle of two bronze strips as convenient to the overall design. In either case, if the contacts are stamped out across the joint strip there will be an area which is completely resistant to most atmospheric conditions, and thus form an ideal contact material.

(To be concluded)

Opportunities Directory

A DIRECTORY of Opportunities for Qualified Men has been published by Cornmarket Press Ltd., 1 Lower James Street, London, W.1, which gives details of some courses for graduates and executives and the types of employment available in a number of firms and public bodies. Free to newly-qualified students, it is priced at 8s. 6d. (bound) and 5s. (paper-back) to others.

Developments in Metal Spinning

BY the introduction of new techniques and machinery, the diameter and thickness of spun components manufactured by Metal Spinners (Newcastle) Limited has recently been greatly extended.

For working the heavier gauge materials, the company has recently installed a high efficiency electro-hydraulic spinning lathe of the latest design. There are at present less than six such machines in Britain.

Greatly increased production rates are obtainable from these semi-automatic lathes. The model installed by Metal Spinners shows a production increase of approximately ten times that obtainable by conventional spinning methods and all spinning operations are carried out mechanically rather than manually.

In the normal type of lathe, a blunt, smooth tipped spinning tool is manipulated by the operator. Considerable physical effort frequently is entailed especially when spinning high tensile or heavy gauge materials. In some cases, three men may be required to operate a spinning tool in order to be able to apply sufficient pressure to the workface.

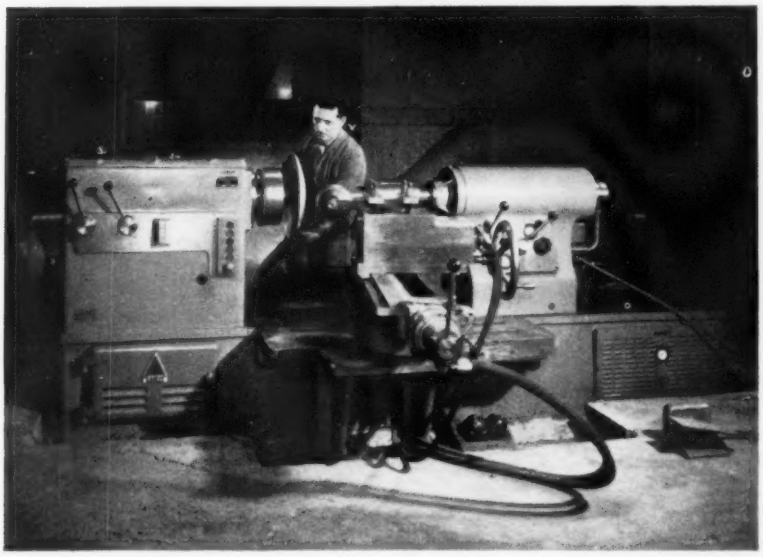
Heavy manual effort is entirely dispensed with on the electro-hydraulic machine, and the question of doubling-up operators does not arise. The conventional spinning tool is replaced by revolving tools mounted in an hydraulically operated compound rest and a constant or variable pressure can be applied at will to the point at which the tool makes contact with the spinning.

The range of spinnings at present being produced by this firm for the industrial and consumer market extends from 5 ft. diameter tank and boiler ends in $\frac{1}{4}$ in. steel, to 3 in. diameter cups in 16 s.w.g. aluminium. As the malleability of black iron or low carbon steel is such that cylindrical shapes can be spun readily in a single operation, much of the firm's production is concerned with seamless casings and tanks of cylindrical outline. Where the blank end of a component is to be left intact there is no wastage of material and the end can be flat, or shaped as required. By using specially designed chucks, blank-ended shapes whose sides are convex, waisted or necked can be produced.

Compared with welded fabrication methods or—in other than extremely long runs of work—press and die stamping processes, metal spinning provides significant economies in time and production costs.

A number of spinnings produced at the Scotswood factory of Metal Spinners (Newcastle) Limited. The steel chuck on the trolley (right) is 3 ft. 4 in. in diameter and weighs 4 cwt. Three more spinning chucks can be seen in the background

A simple convex spinning in $\frac{3}{16}$ in. steel being removed from the chuck on an electro-hydraulic spinning lathe. This machine will accept spinnings of up to 5 ft. in diameter



STANDARD SPECIFICATIONS

Ninety-nine per cent Aluminium Forging Stock, Bars, Extruded Sections and Forgings. (*B.S.3L34*: 1961.) *Aluminium-2$\frac{1}{2}$ per cent Magnesium Alloy Forging Stock, Bars Extruded Sections and Forgings.* (*B.S.3L44*: 1961.) *Aluminium-Copper-Magnesium-Silicon Manganese Alloy Tubes (solution treated and aged at room temperature).* (*B.S.2L62*: 1961). *Price 2s. 6d. each.*

THESE three standards are revised editions of 2L34, 2L44 and L62, prepared in order to introduce amendments necessitated by the revision of L100, "Inspection and Testing Procedure for Aluminium and Aluminium Alloys". During the course of revision, it was decided to include in 3L34 and 3L44 requirements for forgings (not covered by 2L34 and 2L44).

Copies of the above-mentioned standards may be obtained from the British Standards Institution, 2 Park Street, London, W.1.

For the first time since the premises in Whittington Avenue were built for the London Metal Exchange in 1882, the Exchange has undergone major alteration. There have been proposals from time to time since the market was opened after the war, to rectify specific inconveniences, but it was decided, rather than make piecemeal alterations, to carry out a comprehensive reconstruction programme. Members had long suffered from inadequacy of space, inadequate lighting, artificial and natural, and an antiquated and inefficient heating system. But perhaps the worst defect was the unsatisfactory acoustics, a serious drawback as trading is effected by open outcry across the "ring". The reconstruction of the Exchange has been more thorough than was originally foreseen. The most prominent feature, the ring itself, consisting of four long curved benches arranged in a circle, has been retained and successfully renovated. The reconstructed Exchange is to be opened today by the Lord Mayor of London.

BY OUR
METAL EXCHANGE
CORRESPONDENT

LONDON METAL EXCHANGE

UP to the middle of the nineteenth century, Britain was the world's largest producer of copper, and up to 1880 she shared tin honours with Malaya, while in lead it was 1870 before her supremacy was seriously challenged. In zinc, the United Kingdom was never in the running with Belgium and Germany. In the early part of the century, supplies of copper, tin and lead were sufficient to take care of the domestic demand for these metals, but as activity in the non-ferrous industry expanded, it began to be necessary to import additional raw materials from overseas. In fact, from possessing an exportable surplus, Britain became an importer in a big way. This, of course, brought the merchant houses to the fore, and it was not long before business on a large scale had developed. In due course, the expansion that had taken place in non-ferrous metals in Britain was followed by similar developments on the Continent, particularly in France and Germany.

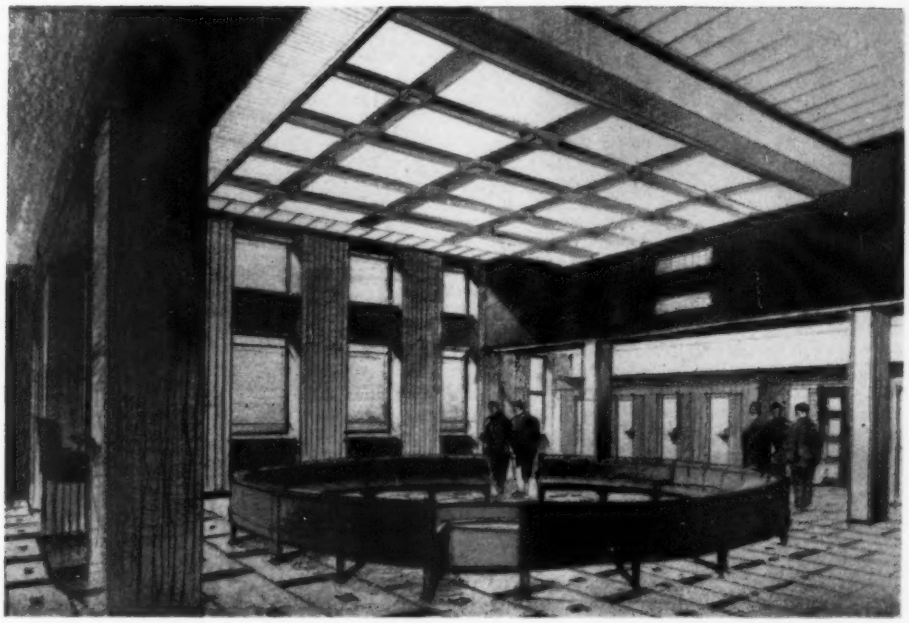
After a time, those merchant houses which had begun in quite a modest way, almost, one might say "dabbling", in non-ferrous metals, expanded that side of their business and became knowledgeable and even expert in all the many aspects of the metal trade. Some remained partially on the fringe by participating only as brokers and working on a commission basis, but others followed the traditional pattern of merchant trading by purchasing and financing the various parcels of metal which were imported into the United Kingdom. Entrepôt business developed, based on London, which emerged speedily as the world's most important centre for dealing in metals, so much so that the list of those operating in non-ferrous metals here was augmented by individuals similarly interested from the Continent, particularly Germany.

As the trade developed and the volume of business passing between one merchant house and another increased, it became irksome to transact business on a "visiting" basis, and consideration was given to the need for some convenient place where all those concerned could meet to transact business together. It is known that dealers used to foregather in the very early days at the Jerusalem Coffee House, in the City, and it can hardly be doubted that regular meetings were held at the Royal Exchange, which was a rendezvous for various trades. Undoubtedly, the trading at these meetings laid the foundation of the futures market in Whittington Avenue as we know it today, for a general pattern of dealing emerged and certain methods were adopted as matters of convenience, which, in due course, became accepted practice.

There were, however, obvious drawbacks to these *ad hoc* meetings and, in due course, some of the more important houses concerned in metal trading found themselves a room in Lombard Street where they could congregate daily to transact the business in which they were vitally interested. As business developed on the international front, all sorts of problems cropped up, not the least of which was the daily publication of prices. One thing led to another and, finally, in 1882, the present Metal Exchange building was opened, where trading has been carried on ever since.

The affairs of the Exchange are administered by the Board of Directors of the Metal Market and Exchange Company, who are responsible for the financial side of the undertaking and for the admission of new members. In addition, there is the Committee, consisting of 15 subscribing members and/or authorized clerks, who are elected annually by voting limited to subscribing members. This Committee meets at regular intervals for discussion of problems arising out of the affairs of the "room". These include changes in the pattern of the official Metal Exchange contracts for dealing in copper, tin, lead and zinc; approval of additional warehouses, and, indeed, everything that "belongs" to the life of the operational side of the Metal Exchange. This may seem a fairly tall order, but it must be remembered that the market is of very long standing and, in a sense, it "disciplines" itself. Moreover, there is a small body of experienced and conscientious officials devoted to the interests of the Exchange and responsible for taking care of the hundred and one minor problems and difficulties which always arise in the running of any enterprise. Nevertheless, much time is ungrudgingly given by members of the Committee, and particularly by its chairman, to the affairs of the Exchange.

The London Metal Exchange is essentially a futures market, but since forward dates inevitably, in due course, become the present time, dealing is practised on the basis of cash and three months, this method now applying to all the four metals. Formerly, lead and zinc were traded on the basis of "ex-ship", with two settlement days in each month, but from January 1 fixed prompts were adopted and the metal is bought or sold in warehouse as with tin and copper. All metal traded must conform to the description in the official contracts, and only registered



An artist's impression of the reconstructed London Metal Exchange

brands may be delivered to the market. A procedure is laid down for the registration of brands, a list of which is available for inspection.

Method of Trading

The method of trading is that of open dealing, i.e. bid and offer across the "ring", as the circle of benches on which members sit is termed. The Exchange is open for business five days a week with the exception of public holidays and Good Friday. By an old tradition, the room is not open for dealing on New Year's Day. Promptly at 12 noon, a bell is rung on the Secretary's rostrum and he calls aloud the time-honoured phrase, "Copper, gentlemen, copper". Dealing begins promptly and continues for five minutes, when it is the turn of tin for a similar period. Lead comes next and zinc follows, so that at 12.20 p.m. the first "ring" is over. There follows a ten minutes interval during which dealers and their clerks may contact their offices and receive further instructions. At 12.30 p.m. the procedure is repeated and at 10 minutes to 1 o'clock the three committee men "prices committee" agrees the day's official quotations, which are then read out by the secretary.

Kerb dealing follows for ten minutes, after which trading ceases until 3.45 in the afternoon, when the midday programme is repeated, except that the interval between the two rings is only five minutes. Again, Kerb dealing follows the termination of dealing in the ring, but it should be noted that all the afternoon prices are unofficial. Nevertheless, this afternoon session is important, if only because by the time trading begins, the New York market has opened and provided London with its trend of values. Every Monday, the Exchange publishes an official figure of the previous week's turnover in all four metals and also details of the stocks held in official Metal Exchange warehouses.

Dealing in copper, lead and zinc is on the basis of units of 25 tons, and in tin of 5 tons. There is virtually no limit to the amount of metal which can be bought or sold on the market and, from time to time, heavy dealing is seen across the ring. Not unnaturally, persistent pressure one way or the other operates to raise or depress the quotation. The London market rightly claims that it provides daily an accurate valuation of the non-ferrous metals, for it is subject to every passing influence, be it political, financial or commercial. Price movements in New York affect the trend of values in London and vice versa. In the ordinary course of events, the forward quotation commands a premium over cash, this contango, or carrying rate, representing, in theory at any rate, the cost of financing the metal for three months, plus the expenses incurred through warehouse rent and insurance. From time to time, however, the contango is replaced by a "backwardation", i.e. a situation in which cash stands at a premium over three months. This occurs as a result of a shortage of early supplies or the threat of it, when bears are driven to cover their short positions as best they can. "Early supplies" in this connection must be understood to mean also stocks in official warehouses.

It will be remembered that trading on the London Metal Exchange was suspended throughout the war and for many years afterwards. Indeed, although dealing in tin futures began again in November 1949, it was October 1952 before lead joined in, January in the following year for zinc, and August 1953 for copper. The copper futures market immediately ran into trouble, for trading "chips", i.e. warehouse stocks, were inadequate and a backwardation developed which persisted for some years. Indeed, there is an impression even now that the maintenance of a contango is somewhat precarious. In devising the official contracts for dealing, it was necessary to ensure that metal would be attracted to the market and yet not too readily withdrawn for consumption. No easy task, it may be said.

London is a marginal market for metals, which means that it is intended to absorb surplus production at times when demand from consumers falls off. Things do not always, however, work out that way in practice, for producers are not keen on their metal getting into merchants' hands, which it may well do if sales are made in Whittington Avenue and the relative metal delivered to the market. From time to time, this policy of amassing rather than disposing of surplus metal to the futures market in London has led to wide price fluctuations.

This matter of fluctuation in the prices quoted on the Metal Exchange is one which has been responsible for much adverse criticism of the market's operation. It has already been suggested that the policy of hoarding stocks rather than disposing of surplus copper on the London market has, in the past, led to wide movement in the price. Apart from that, however, strikes at producing centres have led to a shortage and a scramble for supplies by manufacturers, which inevitably affected the price. Over-production, not countered quickly enough by a cut in output, has been responsible for

forcing down the quotation to an uneconomic level and this has inevitably led to trouble. All these events have been reflected in the daily prices quoted in London, which act as a mirror on such occasions.

Perhaps the major "heresy", based on a complete misunderstanding of the facts, is that dealers and brokers operating in the ring are responsible for lifting and depressing the price. Nothing could be further from the truth, which is, of course, that the metal market is a place where orders from the outside world are executed. For any dealer, however powerful, to operate on a scale great enough to push the price markedly one way or the other would be impossible. In a word, the Metal Exchange, in addition to being the sounding board of world events, is also a market which establishes values accepted as fair and correct in the light of current events and future prospects. On the basis of these prices, many hundreds of thousands of tons of non-ferrous metals change hands every year. This total includes virgin metals, ores and scrap.

Hedging

In addition to furnishing daily values of the non-ferrous metals, the Metal Exchange fulfils a highly important function in that it offers to all concerned with the metal industry a means to protect themselves against losses due to price fluctuations. Very simply, this consists of selling forward on the market a tonnage equal to that held at risk on the books of the operating company and so ensuring a level position. Should the price decline, the loss incurred on the company's holding will be offset by the profit earned on the short position open on the market at the price ruling before the setback occurred. Bearing in mind that the market is open on every business day and that the units of dealing are relatively small, it is plain that an operation of this kind offers considerable flexibility. The advantages accruing from hedging on the metals futures market are widely appreciated, and much of the turnover in Whittington Avenue derives from this activity, but it is, unfortunately, a fact that there are still firms which do not make use of this safety device. It is, of course, open to any fabricator who has taken an order for a supply of non-ferrous metals for forward delivery, to ensure price cover by purchasing an equivalent weight of the three months position, which will be liquidated when physical metal is bought.

Since operations in copper futures began again in August 1953, after a lapse of about 14 years, during which time the Government was responsible for the sale and distribution of the metal in the U.K., there have been one or two attempts at evolving schemes to iron out the daily fluctuations in the price. Chief of these was the R.S.T. stability price plan, which ran from May 1955 to October 1957 and certainly achieved a very fair measure of success, but in the long run it was found that a dual price system led to insuperable difficulties. The point was that the L.M.E. continued to publish its daily quotation on which the buying and selling of all copper, primary and secondary, other than R.S.T., was based.

More recently, the world producers, with the exception of those in the United States, evolved a scheme embodying what has come to be called a "managed price". On this subject, there have been conferences between the consumers and the producers who, it is understood, modified their original plan in deference to criticisms and objections by the users, but so far nothing has emerged as a result of these talks. It has always been understood that one of the chief difficulties was the fact that a fixed price, controlled by the producers, would inevitably destroy the practice of successful hedging, as the managed price would not fluctuate in line with the Metal Exchange quotations. In the extremely unlikely event of the producers evolving a scheme in every way acceptable to the consumers it cannot be denied that much hedging business might be lost to the Metal Exchange, but at the moment it is not thought that the adoption of an alternative method of pricing is at all likely.

All things considered, therefore, it would seem that the Metal Exchange, renovated and refurbished as to its internal structure, may reasonably hope for and, indeed, expect a continuation of present-day activity. Expansion depends, naturally, on the condition of the non-ferrous industry, but here again there are no grounds for pessimism. Judging by the turnover figures in the four metals during the first quarter, it looks as though a total of fully a million-and-a-half tons may be anticipated in 1961. On a rough and ready computation, based on present-day prices, the value of this turnover would appear to be about £275 millions. An impressive figure, which emphasizes the important part trading in non-ferrous metals futures plays in this country.

Reconstruction

The area incorporating the rooms of the Exchange has been adapted from a single into a three-storey building. There is a new roof supported on large steel joists, a new entrance hall and new reading and telephone rooms. The committee room has been completely remodelled.

The new entrance hall, as is appropriate, incorporates a number of metal finishes. Similarly, copper bosses have been incorporated in the new illuminated ceiling of the Exchange. Beaten copper panels encase the supporting pillars, and copper alloys have been used extensively in the finish of furnishings and notice boards, etc.

Although all the work was put out to competitive tender, the Exchange was gratified to find the metals used are the product of member-firms.

Two plaques have been installed in the entrance hall. The first, which is in copper, commemorates the re-opening of the reconstructed Exchange by the Lord Mayor of London. It reads:

"This plaque commemorates the visit of the Right Honourable, The Lord Mayor of London, Sir Bernard Waley-Cohen, on the 28th of April, 1961, to mark the completion of the reconstruction of the London Metal Exchange Rooms, first opened in 1882."

The second plaque has been presented by the contractors. It is in the lead from the old roof, and reads:

"This piece of lead was taken from the original roof of the building and was presented to the Metal Market Exchange Ltd. by the Contractors, Walter Lilly and Co. Ltd., to mark the completion of the reconstruction."

The new reading room contains part of the library, including statistics and works of reference, the principal trade publications and the daily papers.

Offices have been built on the two new floors above the rooms of the Exchange.

A clock-controlled system replaces the manually-operated push-bell to indicate the end of trading periods. As an active session can be extremely noisy, it was not uncommon for a dealer in the heat of the moment to miss the signal for the end of a period and attempt to continue to trade in the previous metal. (By tradition, such "offences" cost the dealer 2s. 6d.)

The new system to indicate the end of a trading period comprises a master clock controlling a number of "slave" clocks. (At least one clock is visible from any part of the Exchange.) The master clock also controls a "programme instrument", which indicates by means of a bell the beginning and end of each five minute trading period.

The system is supplemented by illuminated panels at both ends of the Exchange to indicate the metal traded in at any one time. The method of indicating the metals is by alchemical symbols.

Among the many other new innovations is a lamp-signalling device which automatically informs members or their clerks of telephone calls. Each member-firm has an illuminated number visible from the ring.

The new system by-passes the switchboard, which previously had to deal with 60 extensions. The calls are routed direct to firms. During trading sessions, when all the telephones are in constant use, the switchboard used to be continually swamped by calls.

The telephone booths have been re-arranged to bring them nearer to the ring. The continual demands for more extensions had led over the years to many being sited in rather inaccessible positions, making it difficult for dealers and clerks to keep their offices and clients in close contact with the movements of the market.

A new heating system has been provided which is fired by oil. The boiler serves a radiator system which extends throughout the Exchange Buildings.

Reviews of the Month

NEW BOOKS AND THEIR AUTHORS

POLISHING

"Mechanical Polishing." *By Burkart, Silman and Draper. Published by Robert Draper Ltd., 85 Udney Park Road, Teddington, Middlesex. Pp. xxxiv + 267. Price 60s.*

THE polishing industry has long felt the need for an informative textbook, and people in the industry will welcome a stimulating and comprehensive new work by three authors well known in this field.

This book aims at producing a survey of polishing theory and practice in Germany, England, and America. It is based on two German books by Walter Burkart: "Modernes Schleifen Und Polieren" and "Vom Hand—und Automatenpolieren", published in 1956 and 1959. The resulting integration is not wholly satisfactory, and an informed reader is likely to be irritated by the absence of a logical plan to the presentation. Furthermore, he will miss any critical appreciation of the merits and defects of the various components and machines which are otherwise admirably described.

The book deals largely with the practical aspects of polishing, although there is a brief introduction covering some basic theory. Manual and automatic grinding and polishing, barrel finishing and abrasive blasting of metal, plastics, wood, lacquers, glass, horn and ivory are dealt with, the polishing of metals naturally taking pride of place. The polishing of non-metallic materials has had to receive brief treatment, but the information is lucid and as techniques are closely guarded secrets in the industry, the text is as complete as may be expected.

Subjects covered include the measurement of surface finish, the applications of abrasives, dust control and fire hazards, bobs, mops, brushes and belts. Comparison is made between mechanical, electro and chemical polishing; lapping, honing and superfinishing are considered.

The range covered by the book is, in fact, most comprehensive, and the techniques discussed are up to date, the only noticeable omissions being the air-drying abrasive emulsions and the use of tufted nylon belts for polyester polishing. However, the passages covering High G polishing, vibrator polishing and grit blasting are rather confused, descriptions are not placed in a logical part of the book and the uninformed reader is unlikely to be able to learn of the place in the industry of these new developments.

While this textbook does not, and, of course, should not, pretend to be a buyer's guide, it will, nevertheless, be useful in indicating sources of supply of reliable materials and equipment. It would have been more useful in this sense if a more complete index had been used. Indeed, to fulfil its main purpose as a work of reference it requires considerably improved indexing, and more references to existing published work would have been advantageous.

The style of writing is explicit and very easy to read, and the enormous amount of information that has been packed into 255 pages makes criticism of its content seem unreasonable. The book is well produced with excellent illustrations and, with the foregoing reservations, is to be recommended, particularly to readers who are not "skilled in the art", but who wish to obtain an authoritative survey of modern industrial polishing techniques.

J. H. B.

METALLURGY

"Metallurgy for Engineers." *3rd edition. By E. C. Rollason. Published by Edward Arnold (Publishers) Ltd., 41 Maddox Street, London, W.1. Pp. viii + 392. Price 20s.*

UNDOUBTEDLY, the earlier editions of this book will be known as widely among students and engineers whose interests or studies lie on the fringe of metallurgy as its author is in metallurgical circles. For those who already know the book, then, there need be little added, except perhaps to quote from the preface to this third edition: " . . . since the last edition there has been a rapid technological development in the use of titanium . . . and of new metals in the nuclear energy field . . ." Some of these developments are included in the revision and by the addition of new material.

New material includes brief outlines of techniques such as zone refining, methods of revealing dislocations, new techniques of steelmaking, and details of die steels, magnets and high tensile steels. A number of additions has been made to the data on precipitation hardening of stainless steels and the treatment of cast irons.

To those to whom the earlier editions are unfamiliar, it might be added that the emphasis throughout is on engineering aspects of metallurgy rather than on fundamental concepts of metal structures, laboratory processes, or properties of metals. A glance down the chapter headings reveals that the subjects dealt with are those that are likely to be of direct interest to the engineer, although equilibrium diagrams, pole triangles and pole figures, crystal orientation and an introduction to the structure of the atom are included. The book thus avoids being a merely superficial glance at metals; a phenomenon not uncommon among the spate of books that have appeared over the past few years.

Intended primarily for students of engineering taking university and college courses, this edition should be worthy of a place on the shelves of all engineers, and not a few metallurgists, who need a comprehensive but concise outline of the metallurgical principles and techniques involved in the fabrication and semi-fabrication of the major metals in commercial use at the present time.

ENGINEERING METALLURGY

"Engineering Metallurgy—Part II." *By R. A. Higgins. English Universities Press, 102 Newgate Street, London, E.C.1. Pp. xi + 404. Price 25s.*

MANY owners of Part I of "Engineering Metallurgy" will find Part II an essential purchase, especially those who are preparing for professional examinations. There is sufficient in the text to meet the needs of the usual range of H.N.C. (Eng.) examination questions.

The book provides a concise comprehensive catalogue of processes concerned with metallurgical transformation and treatment. It is the accuracy and clarity of the text which make this book so effective to the student, but it is unlikely that "Engineering Metallurgy" will be regarded as a source of reference for those who are concerned with the development and supervision of metallurgical processes. The student with specialized interests and eagerness to go beyond the text book will find that the references for further reading are of great value, although an unduly high proportion of these are for U.S.A. literature. The abundance of sketches and photographs is a feature to be commended.

The main classifications of the text are melting and casting methods, deformation processes, heat-treatment processes and joining processes. Unfortunately, one notes the omission of certain items which, if included, would give an up-to-date appeal and show an awareness of the latest industrial practices. The melting furnace range, for example, does not include the mains frequency coreless furnace, and the section on castings would benefit by more information on inspection techniques, notably X-ray and gamma ray methods. The latter are not mentioned at all.

In the deformation section, rolling, forging, extrusion and drawing processes receive separate attention. Greater distinction between cold and hot working rolling mill plant would have been desirable and in this section it did not prove easy to relate each illustration to the text.

Chapter XII is a welcome inclusion of the processes which rarely claim attention during tuition in process metallurgy—shearing, bending, stretch forming, coining and spinning.

The three chapters on heat-treatment

may not give a lot of metallurgical information — refer Part I — but the whole field of equipment is well surveyed with important emphasis on protective atmospheres and mechanical furnace units for work handling. Several pages are devoted to quenching, and this topic deserves close attention to fundamental principles by contrast to all the proprietary information circulated to industry.

In discussing joining, it would have been advisable to have explained the metallurgical characteristics of the materials suited to various welding methods. Preference, instead, has been given to a survey of process equipment, without reference to the inspection of welds, particularly by means of modern non-destructive test techniques.

The final pages of Chapter XX provide an unexpected "cadenza" to the entire work. They feature brief notes on "New Metals"—beryllium, hafnium, zirconium, tantalum, etc.—and, by so doing, remind the student that, having reached the end of the book, his work is only just beginning.

P. E. W.

Men and Metals

At the annual general meeting of the Aluminium Development Association, held in London last week, **Mr. Gerald W. Lacey,** C.B.E., B.Sc., F.R.I.C., took office as President for the year 1961-62.

Mr. Lacey is assistant managing director (Overseas) of the British Aluminium Company Limited. The retiring President of the Association, **Mr. W. Brining,** F.C.A., was appointed Vice-President; **Mr. R. T. Raven** (Birmetals Limited) was appointed chairman of the Executive Committee, and **Mr. P. S. W. Swabey** (general manager of development, The British Aluminium Company Limited) was elected to the committee.

At the annual meeting of The International Nickel Company of Canada Limited the following retiring directors were re-elected: **The Hon. Lewis W. Douglas; J. Roy Gordon,** President; **G. Arnold Hart,** M.B.E.; **H. R. MacMillan,** C.B.E.; **The Rt. Hon. Viscount Margesson,** P.C., M.C.; **R. Samuel McLaughlin; H. C. F. Mockridge,** Q.C.; **Theodore G. Montague; Sir Ronald L. Prain,** O.B.E.; **George C. Sharp; John F. Thompson; The Rt. Hon. Viscount Weir,** C.B.E.

A new appointment at The British Oxygen Company Ltd. is that of **Mr. G. C. Richardson,** who has been appointed export manager, Overseas Division. Previously, Mr. Richardson was general sales manager, J. H. Carruthers and Co. Ltd., and before that he had been assistant sales manager, Langley Alloys Ltd., Slough.

In succession to **Mr. F. Blackmore,** who is now manager of equipment development, technical division, The British Oxygen Company Limited, **Mr. W. E. Hughes** has been appointed director and general manager of British Industrial Gases Limited at Enfield. Mr. Hughes joined B.I.G. as a sales representative in 1947 and became sales manager in 1953. He is succeeded as sales manager by **Mr. H. L. Pierson,** formerly field manager, who has been with the company for 31 years.

The Governing Body of the Imperial College of Science and Technology (London University) have made a number of elections to fellowship of the college. Among those elected was **Dr. J. H. Watson,** C.B.E., M.C., Ph.D., A.R.S.M., M.I.M.M., Chief Assayer, Royal Mint, hon. secretary and treasurer, Royal School of Mines Association.

With an itinerary that includes Detroit, Chicago, Evanston, Toronto and Montreal, **Mr. J. E. C. Bailey,** C.B.E., M.Inst.Ex., chairman and managing director of Baird and Tatlock (London) Ltd., Hopkin and Williams Ltd. and W. B. Nicolson (Scientific Instruments) Ltd., is visiting America and Canada to continue discussions with American associates on the further developments in the "Analmatic" range of process control instruments. During his stay, Mr. Bailey attended the annual meeting of the Scientific Apparatus Manufacturers' Association at White Sulphur Springs from April 23 to 27.

For the year 1961-62 the following officers of the Metal Finishing Association have been elected: National chairman and Birmingham regional chairman, **Mr. C. Wharrad** (Britachrome Ltd.); deputy national chairman and London regional chairman, **Mr. R. Gerhardi** (Gerhardi Bros.); deputy London regional chairman, **Mr. W. G. F. Thornley** (Cu-Ni-Crafts Ltd.); Birmingham deputy chairman, **Mr. C. E. Moore** (Ashton and Moore (C.) Ltd.).

Recently appointed overseas director on the main board of Imperial Chemical Industries Limited, **Mr. M. J. S. Clapham,** M.A., has agreed to continue for a further term as President of the Institute of Industrial Supervisors.

Appointments announced by the Metal Industries Group include those of **Mr. S. A. Hunter** to the board of Foster Transformers and **Mr. P. Huggins** to the board of Lancashire Dynamo and Crypto.

An eleven-country tour is being undertaken by **Mr. W. J. Vaughton,** deputy managing director of The Delta Metal Company Limited and managing director of James Booth Aluminium Company Limited. He will visit Brazil, Peru, Venezuela, Canada, United States, Japan, Hong Kong, Thailand, India, Kenya and South Africa.

Appointed works manager of Sheepbridge Stokes Limited, **Mr. J. C. Childs** was previously with an associated company, Sheepbridge Alloy Castings Limited, as methods engineer.

A member company of the Sheepbridge Engineering Group, Sheepbridge Equipment Ltd., Chesterfield, have appointed **Mr. C. E. Hutchinson,** A.M.I.Mech.E., as general sales manager.

Appointed manager of the machine tool control department of Ferranti Ltd., Edinburgh, **Mr. H. G. Hinckley** replaces **Mr. D. T. N. Williamson,** manager of the department since its inception in 1952, who has left to become director of research and development at Molins Machine Company Ltd., in London.

Following the appointment of **Dr. R. Spence,** C.B., F.R.S., as deputy director of the Atomic Energy Research Establishment, Harwell, **Dr. W. Wild** has been appointed head of the Chemistry Division. He has responsibility for the scientific work of three branches: Chemical Processing and Reactor Chemistry; Radiation Chemistry and Solid State Chemistry; Radiochemistry. **Mr. A. A. Smales,** O.B.E., head of the Analytical Chemistry Branch, has been given the status of a division head and will be directly responsible to the Director, A.E.R.E., for the scientific work under his control. His branch will continue to use the general administrative services of the Chemistry Division.

Among the CIBA Fellowships awarded by the Advisory Panel of the CIBA Fellowship Trust were those to: **Dr. J. S. Littler** (Oxford University) for post-doctorial study at the E.T.H. Zurich (Chemistry); **Mr. H. Stern** (Oxford University), for post-doctorial study at Brussels University (Theoretical Physics); **Mr. F. I. B. Williams** (McGill University and Oxford University), for post-doctorial study at Liege University (Solid State Physics). The following Fellowships previously awarded were renewed for a further year: **Dr. W. D. Hamilton,** at present working at Uppsala University (Nuclear Physics); **Dr. B. L. Mordike,** at present working at Göttingen University (Physical Metallurgy).

Industrial News

Home and Overseas

Scrap Merchants Visit Delta

A party of 35 members of the National Association of Non-Ferrous Scrap Metal Merchants recently toured the works of **The Delta Metal Co. Ltd.** and three other companies within the Delta group. Amongst the party was the President, Mr. H. G. Shields, and the Vice-President, Mr. A. G. Robinson. They were received on behalf of Delta by Mr. E. Cashmore, group buyer.

The programme included a tour of the Dartmouth Street Works, lunch at the Delta Sports Pavilion, followed by the party splitting into two groups to visit Elkington and Co. Ltd., the well known silversmiths, and Conex-Terna Ltd., brassfounders, and Hot Pressed Products Ltd., hot brass pressings.

Electroless Nickel Plating

A sub-licence for the operation of the Kanigen electroless nickel plating process has been granted by **Albright and Wilson (Mfg.) Ltd.** to **Fescol Ltd.**, who are planning to erect the necessary plant at their works at Brownhills, Staffs.

Kanigen chemical nickel plate is a nickel-phosphorus alloy containing about 8 per cent of phosphorus. It has extremely low porosity and is hard (1,000 V.P.N. after heat-treatment) and corrosion- and wear-resistant.

Kanigen plate has especial value for many aircraft applications because the plating follows more precisely than any other known method the contours of even the most complicated of cast and machined parts. The plating solution deposits a continuous and completely uniform plate on the most complex components.

Kanigen is recognized both by the Ministry of Aviation and by the Air Registration Board, by whom it has been approved under D.T.D. 900/4505 and A.I.5112/57 respectively.

Filtering Rolling Mill Coolant

For use with the new 72 in. cold mill which is now being installed by **James Booth Aluminium Ltd.** at Kitts Green, Birmingham, a rotary coolant filter unit, said to be the largest aluminium structure of its type, has been designed by The Loewy Engineering Co. Ltd. in conjunction with James Booth's project engineers. The unit was fabricated by Windshields of Worcester Ltd. It measures 12 ft. high, over 20 ft. long and 10 ft. wide, and contains 8,000 gal. of paraffin coolant, the filtration equipment itself, and two 830 gal/min. capacity coolant circulating pumps.

The unit consists, basically, of a large storage tank with a 10 ft. diameter drum, 9 ft. long, mounted transversely across the inside and free to rotate about a horizontal axis. The outside of the drum is of fine wire mesh and over it are led two 50 in. wide, continuous, tensioned webs of filter paper, with the feed and take-up mandrels located above the main tank.

Used coolant enters the storage tank through metal filter screens and then passes through the filter paper—which removes all solids larger than 4 microns—into the centre of the drum. The filtered coolant is then transferred into the pump suction compartment to complete the filtration cycle. An automatic system monitors the liquid levels inside and outside the drum so that reduced filtration rates, due to sludge accumulation on the surface of the paper, are compensated for by the paper being reeled up on the "dirty" side and clean paper being fed from the feed reel. The winding process is powered by an air motor.

The effective filtration surface of the filter paper is 190 ft^2, so that at maximum throughput each ft^2 of paper filters 4·4 gal/min. of coolant.

An agitator unit, oscillated by a geared electric motor and connecting rod, fits closely round the periphery of the drum to prevent sludge deposition on the bottom of the tank.

Light alloy extrusions and plate—mainly Duralumin H and MG5—and stainless steel nuts and bolts, have been used in the construction to prevent possible contamination of the coolant. The welding processes used were Argonaut and Argonarc.

Showing at Moscow

Already exporters of large industrial plants to the Soviet Union, the **Vickers Group of Companies** will have the largest individual company pavilion in the grounds of Sokolniki Park when the British Trade Fair is opened in Moscow on May 19. The exhibits cover a wide range of the group's products, and among them will be the Vickers hardness-testing machine and a range of stainless steel products and castings.

An Electronic Air Filter

Marketed for industrial applications by **W. C. Holmes and Co. Ltd.** since 1956, the Trion electronic air filter has been redesigned to meet the arduous operating conditions encountered in industry, and is to be known as the Industrion electrical air filter.

The new filter is of much sturdier construction than its predecessor; the collecting cell is fabricated from a heavy gauge aluminium, and the supporting framework and ionizing section support bar have been strengthened. Another advantage is that the insulators are now positioned out of the main air stream; this facilitates cleaning and ensures greater reliability.

The associated electrical equipment has also been improved, and there are now two standard sizes of power units which, in various combinations, meet the power requirements of individual installations.

The Industrion range is completed by the Industrion oil mist precipitator, which has been specifically designed for the elimination of oil mist and smoke emanating from high speed cutting, grinding and machining operations.

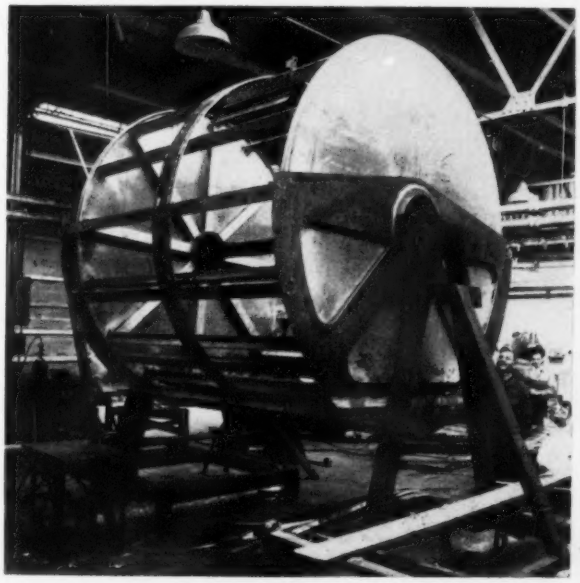
Automation in Continuous Casting

An order has been received by **Honeywell Controls Limited,** London, from the Continuous Casting Company Limited for the complete instrumentation of a twin-strand continuous casting machine to be installed at the Abbey Works of the Steel Company of Wales.

The machine will be instrumented by a new integrated two-wire electric system known as the ElectriK Tel-O-Set. The system will control and record the flow of cooling water and lubricant at various points and will monitor certain local flows; it will record and integrate the casting speed and record temperature rises across the moulds. Provision is made for a Honeywell data handling unit to be fitted later.

Course in Applied Pneumatics

In response to a widespread demand, the *Journal of Applied Pneumatics* announces the introduction of "A Course in Applied Pneumatics". The courses, which will be held several times a year, are intended to provide designers and users of pneumatic equipment with a comprehensive background and appreciа-



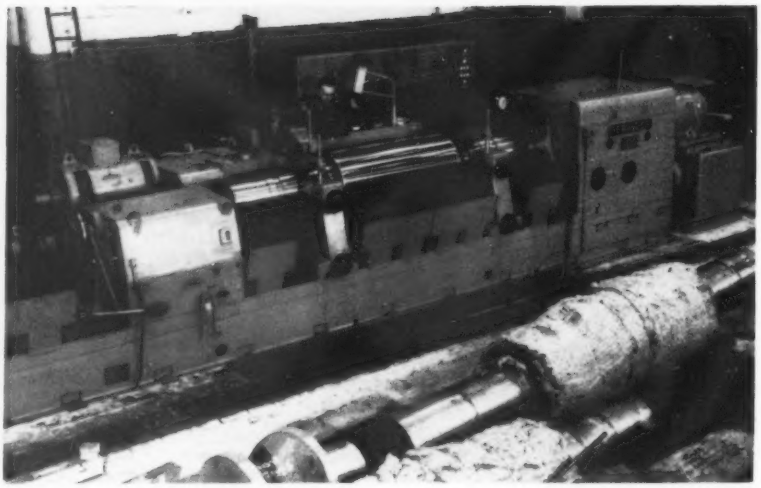
The drum and agitator of the new rotary coolant filter for use with James Booth's new 72 in. cold aluminium rolling mill, shown mounted on alignment jigs in the works of Windshields of Worcester Ltd.

tion of the applications of compressed air equipment in industry.

The first course in the series will be held in the early autumn, and full enrolment details and syllabus can be obtained from The Director, "Journal of Applied Pneumatics", Parkshot, Richmond, Surrey.

Roll Grinding

For the high-precision finishing of rolls for strip and plate mills, a Herkules WS600 grinding machine has been newly installed by **Armstrong Whitworth (Metal Industries) Ltd.**, Close Works, Gateshead on Tyne, 8. It can grind rolls of up to 42 in. in diameter and 20 ft. in length. The speed at which a roll can be turned is infinitely variable between 4-32 r.p.m., and the speed of the 5 in. diameter grinding shaft is infinitely variable between 350-830 r.p.m. The machine is the latest addition to a number of new pieces of plant which have been installed at Close Works. Together with a new roll foundry, opened in February, they have brought the company's roll-output capacity up to 15,000 tons a year.



The Herkules WS600 grinding machine installed by Armstrong Whitworth (Metal Industries) Ltd. at Gateshead on Tyne

Bonded Aluminium Lorry Panels

Side and rear panels for lorry bodies are now being constructed by bonding aluminium skins to inner ribs with "Redux" adhesive made by CIBA (A.R.L.) Limited. A recent example is that of a lorry delivered to the Delta Metal Co. Ltd., of Greenwich.

This bonded construction eliminates the unsightly cracking of paint around rivet heads and, by the use of piano hinges, completely smooth sides can be obtained, simplifying painting and cleaning. The panels for this lorry were made by Bonnallack Limited with aluminium supplied by James Booth Aluminium Limited.

Titanium at Achema

Showing for the first time at the Chemical Engineering Exhibition and Congress at Frankfurt in June next, **I.C.I. Metals Division** will feature the varied uses of I.C.I. titanium in chemical and electrochemical plant. This exceptionally corrosion-resistant material is extensively used for making or lining chemical vessels and for equipment ranging in size and complexity from valves, pumps and anodizing jigs to heat exchangers, bleaching plant and gas scrubbing equipment.

Marston Excelsior Ltd., an I.C.I. subsidiary company, share the display. They specialize in the fabrication of aluminium, titanium and other non-ferrous metals, stainless steel, reinforced plastics laminates and synthetic rubbers. Examples on show include a titanium heat exchanger and a titanium-lined steel vessel with solid titanium internals. "Portolite" flexible tanks for the bulk transport of liquids and "Marex" laminated plastics industrial fans are also featured.

Products for nuclear engineering include fuel cans and other reactor components in magnesium and zirconium alloys, beryllium, niobium, hafnium and vanadium, and specialized fabricated assemblies.

Proportional Controller

For stepless proportional control of electrical loads using magnetic amplifier and saturable reactor, a new millivoltmeter instrument known as the Pyr-O-Volt is announced by **Honeywell Controls Limited**. It is an indicating instrument. The Pyr-O-Volt controller 105R12 is an inexpensive current-proportioning instrument with no contactors. It has a continuous output of 3-7 milliamps working into an impedance of 4,000 ohms or more when used as the input to a magnetic amplifier. It will control saturable core reactors up to 100 kVA, with provision for control of larger reactors.

Among important features are the straight line control, automatic fail-safe, built-in voltage regulation, plug-in design, adjustments on the instrument itself, connection and servicing from the front.

In the same family is another new instrument, the millivoltmeter indicator 105X11, which has a high quality moving coil movement and a plug-in design.

These instruments are considered likely to find application in metal producing and processing, ceramics, plastics extrusion, and other industries. They could be used in research, also.

Prefabricated Heating

News from **Electrothermal Engineering Ltd.** concerns the release of their modular flexible furnace, which provides "off-the-shelf" heating up to 1,000°C. having numerous applications. Custom-built units are also available with temperatures up to 1,500°C.

Factory Extensions

A further extension of covered area at **Faulkners Ltd.**, manufacturers of drop forgings, has recently been completed. The new extension follows two other buildings erected in 1959 which then doubled Faulkners' existing heat-treatment department. The larger construction was 123 ft × 37 ft. span and coupled to a smaller building, 78 ft. 6 in × 30 ft. span, both 18 ft. to the eaves.

The new extension is being built on to the longest side of the department, linking up with the original steel buildings and the earlier structure. It will broaden considerably the existing layout of the factory and will permit installation of additional furnaces. With a length of 123 ft. and 40 ft. span, and rising to a minimum height of 19 ft. to the eaves, the new building will be insulated in ½ in. Celotex "Highlight" to the roof only, excluding the area occupied by two runs of Corroglaze roof lights. A further run of Corroglaze vertical lights have been fitted in one end of the building. Ventilation is by nine Colt ventilators installed in the roof.

The newly completed building will house additional equipment for the heat-treatment of drop forgings, shot blasting machinery and various inspection processes, together with a despatch bay. Faulkners Ltd. are an associate company of the London electroforging producers, Omes Ltd.

Testing Equipment

It is announced by **Instron Ltd.** that their precision testing equipment is now made at a new factory at High Wycombe, Bucks. Instron offers a unique range of equipment for material testing, providing the greatest precision and versatility. Two basic Instron models measure tension, compression, hysteresis and elastic modulus of virtually all materials, including all metals, plastics, natural and synthetic fibres, rubber, textiles, wood, paper, glass, etc. The range of Instron machines is from 2 gm. to 5 tons. Associated equipment includes rheometers for the study of flow behaviour in polymer melts, electronic integrators and XY recorders, and set-ups for radioactive testing.

European Study Tour

On Thursday of last week, four members of the sales organization of Aluminium Limited of Canada (Alcan) arrived in this country from North America to start a concentrated five-week European tour. All are specialists in the use of aluminium in the building and constructional industry, and they plan to visit leading manufacturers in this sphere and also important applications. In the United Kingdom, arrangements have been made by **Alcan Industries Ltd.** and Alcan (U.K.) Ltd.

The objective of this tour, which is thought to be the first of its kind in this field, is primarily to increase the fund of experience of aluminium in service in all climates and conditions that Alcan, an essentially international organization, believes to be one of the most valuable services that they can offer their customers. As well as accumulating information from European users of aluminium, the visitors will obviously

make available to them their own knowledge of experience in other parts of the world.

The itinerary in this country will include visits to manufacturers of windows and curtain-walling, prefabricated buildings, roof decking, and specialists in finishing processes. There will also be exhaustive discussions with the Aluminium Development Association and with the Alcan companies. In Europe, the group will visit manufacturers, associates and applications in Belgium, Holland, Germany, Switzerland, Italy and France.

U.K. Agents

News from **Headland Engineering Developments Ltd.** is that they have been appointed agents for Ultrasonic Industries Inc., of New York, and the full range of diSONtegrator ultrasonic cleaners is available in the United Kingdom through them.

New Spray Booth

A new version of their Nopump spray booth has just been introduced by **Alfred Bullows and Sons Ltd.** This is a self-contained "packaged" unit which can be used virtually anywhere and is said to be the first Nopump booth of this type to be offered in this country.

Being a Nopump spray booth, it embodies the revolutionary features inherent in this design, i.e. no circulating pump, filters, pipes or nozzles, complete reliability, infrequent maintenance, reduced space requirement, etc.

The new booth is of monoform construction in 16 S.W.G. sheet metal and is 5 ft. wide, 4 ft. overall depth, and has a height of 9 ft. 2 in. to the fan. It is offered in two versions; the standard bench type unit costs £260, and can be converted to full depth type quickly and easily by the use of a conversion kit which costs an additional £20.

Scientific Instruments

An announcement from **Aveley Electric Limited** concerns their appointment as sole U.K. agents for the Bach-Simpson range of top-quality measuring, testing and control instruments. The Bach-Simpson Co. is a completely autonomous Canadian Co. of high repute, producing the Simpson line of instruments in Canada entirely from its own resources, but sharing with the Simpson Electric Co. (Chicago) joint engineering and mutually advantageous development projects. The Bach-Simpson merchandising interests lie exclusively within Canada and the British Commonwealth.

The range of instruments which will be available to the British market will include multi-range test equipment, panel mounted control indicators, frequency and running time meters, components, educational instruments, radio and TV service equipment, laboratory apparatus, oscilloscopes and a wide range of portable instruments.

Industrial Safety

Because of the rising trend of accidents at work, exceptional importance is attached to this year's **National Industrial Safety Conference** at Scarborough from May 12 to 14, at which over one thousand delegates will be present. The provisional Ministry of Labour accident figures recently announced show an increase in both non-fatal and fatal factory accidents for 1960 as compared with 1959. The former have risen by 15,931 to 189,404, while the figure of 665 fatalities in 1960 shows a rise of 67 deaths.

One of the main purposes of the Conference, which is organized by the Royal Society for the Prevention of Accidents, is to improve the techniques of industrial safety officers in their struggle to reduce accidents, and an interesting programme of technical Papers has been arranged. The Conference begins at 8.30 p.m. on Friday, May 12, with the opening address by Sir Howard Roberts, RoSPA's President.

In conjunction with the Conference, a trade exhibition of industrial safety appliances will be staged at the Corner Café and Spa Ballroom. The eager response to an invitation to participate indicates the importance which the exhibitors attach to it and reflects its influence on this side of industrial life.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week fell 66 tons to 10,117 tons, comprising London 4,279, Liverpool 3,720, and Hull 2,118 tons.

Copper stocks fell 25 tons to 14,942 tons, distributed as follows: London 625, Liverpool 12,217, Birmingham 100, Manchester 1,950 and Hull 50 tons.

Lead duty-free stocks fell 3 tons to 8,061 tons, comprising London 8,036 and Avonmouth 25 tons, while in-bond stocks remained unchanged at 3,868 tons, all supplies being in London.

Zinc duty-free stocks fell 181 tons to 4,120 tons, comprising London 2,810, Liverpool 1,290, and Glasgow 20 tons. London in-bond stocks fell 50 tons to 725 tons.

Change of Address

An announcement has been made by the **Consolidated Zinc Corporation Limited** to the effect that, as from Tuesday, May 23 next, the London address and telephone number of many of their companies will be changed from 37 Dover Street to 6 St. James's Square, London, S.W.1, telephone Whitehall 5411.

Research Conference

Torquay is to be the venue this year of the Research Conference of the **Coil Spring Federation** and its Research Organization. It will be held at the Palace Hotel from May 11 to 14, and a record number of delegates is expected.

The conference programme includes a technical session at which Mr. R. A. Varo will present a research Paper dealing with the static mechanical properties of British, Swedish and German spring wires. Of particular interest this year will be the report of the Director of Research, Mr. R. Haynes, reflecting the increasing activity of the Research Organization both in the laboratories at Sheffield and in the "field".

Lightweight Wheels

According to news from Detroit, U.S.A., strong, lightweight wheels with brakes that will not fade will probably be the next major application of aluminium in automobiles. **Kaiser Aluminum and Chemical Corporation** make this prediction on the basis of results from a series of tests on integral aluminium wheels and brake drums.

As a result of these tests, the Corporation believes that the aluminium wheel eventually will become standard on American cars, replacing the steel disc wheel. The chief development engineer for the Corporation and designer of the integral aluminium wheel-hub-drum, said that the wheel's braking advantage is achieved by aluminium's ability to dissipate heat. The entire aluminium assembly acts as a heat sink, he says, dissipating the heat generated by friction of the brake lining against the drum insert.

New Technical Centre

Birmingham is to have a new technical centre provided by **Guest Keen and Nettlefolds (Midlands) Limited.** In this centre will be gathered all the "know-how" of fastening one thing to another that the G.K.N. group of companies has acquired over the last 130 years.

The centre will not only be used for the training of the group's personnel but will be open for use by customers' staffs for either short or long visits. The official opening of the new centre will take place on May 26 next, and will be performed by Councillor Pritchard, who will be Mayor of Smethwick by that date, and is also an employee of the screw division of the company.

Heat-Treatment in Scotland

It is learned from **British Furnaces Limited** that they have recently received orders for gas carburizing equipment for the Scotstoun factory of Albion Motors. The contract covers four Super Allcase sealed quench furnaces, complete with fully automatic sequence control, together with the necessary Dew point controlled "RX" endothermic atmosphere generating plant, and other ancillary equipment, such as tempering furnace power-operated charging machine, etc. This plant will provide completely up-to-date final heat-treatment for transmission gears.

Showing to Russians

At the British Trade Fair, Moscow, **Sir James Farmer Norton and Company Limited** will be operating one of their patent centreless bar turning machines. From the range of machines available capable of turning bars up to 12 in. diameter and peeling bars up to 24 in. diameter, the No. 2 machine has been selected for this exhibition.

London Meetings

On Thursday next, May 4, the eighteenth annual meeting of the **Association of Bronze and Brass Founders** will be held, following a general meeting of the Association, at the Connaught Rooms, London, W.C.2. The meetings will commence at 10.30 a.m.

European Foundry Industry

For the past seven years, the principal foundry industries of Western Europe have collaborated closely in matters of common concern. This is natural in view of the developing interest for or against European economic co-operation. The organ of this collaboration is the **European Committee of Foundry Associations,** of which the United Kingdom foundry industry—ferrous and non-ferrous—is in membership.

Now the European Committee has issued an attractive tri-lingual (English, French, German) brochure to explain to foundrymen at large, and to other industrialists, technicians and scientists, what it is and what it does.

The brochure is illustrated, and outlines briefly but clearly the economic importance of the contribution to industry made by Europe's foundries and their social importance as a means of livelihood to several hundred thousand workpeople. It emphasizes the fact that the foundry product, the casting, enters in some way, directly or indirectly, into the lives of peoples at nearly every point.

Metal Market News

THE Copper Institute figures for March were issued last week, the details being as follows in terms of short tons of 2,000 lb.: inside the United States crude copper production was 108,418 tons compared with 97,682 tons in February, while the output of refined rose from 134,812 tons to 151,833 tons. Deliveries of refined copper to consumers went up from 93,029 tons to 117,924 tons, but stocks of refined copper in producers' hands dropped from 147,799 tons to 139,562 tons. Outside the United States there was a 26,000 tons uplift in the reserves of refined copper, from 310,052 tons at February 28, to 336,167 tons at March 31. Output of crude copper at 217,692 tons was up by about 35,500 tons over February, and refined copper production at 187,220 tons compared with 169,725 tons in the previous month. Deliveries to consumers rose by 16,000 tons to 208,932 tons. These figures are remarkable, if only because they show no sign of the cutbacks in production which have been advertised. It will be noticed that on balance world stocks rose by 18,000 tons, which is quite a figure, coming as it does on the heels of increases reported in earlier months. Stocks of copper in L.M.E. official warehouses at the beginning of last week fell by 401 tons to 14,967 tons, but the report that the Roan Antelope strike had been settled probably upset any tendency to advance on account of the lower L.M.E. figure of copper in stock.

Trading in copper futures was somewhat erratic from one day to the next, but, without Kerb dealing the turnover for the week totted up to 11,500 tons, which is probably fully up to average for this metal. Finally, the close on Friday afternoon was £228 15s. 0d. for cash and £230 10s. 0d. for three months, these prices showing an advance of 15s. in cash and of £1 in three months. The contango, therefore, widened by 5s. to 35s. In the States, the threat to the stability of the Custom Smelters price was again in evidence through an advance of ½ cent in the quotation for copper scrap. It would appear that business with consumers last week was not very brisk, and the fact seems to be that at around £230 interest by the users tends to dwindle. Indeed, not a few users are of the opinion that the value of standard copper today ought to be nearer to £220 than £230. Unquestionably, the increase in crude production of about 36,000 tons in the world figures, even allowing for the fact that February was a short month, has caused no little surprise and some cynical comment on the effectiveness of the curtailment programme. Nevertheless, it will be noticed that this increase is just about balanced by the higher figure of deliveries to consumers.

Once again the tin market was active and firmer with a turnover of fully 1,200 tons. Warehouse stocks at 10,183 tons were lower by 98 tons. Undoubtedly, sentiment favours a higher price for tin, and there is talk of the quotation climbing up to £880. Last week saw the price closing below the best at £846 cash and £852 three months, these figures registering a gain of £9 in prompt and £9 10s. 0d. in forward. Lead put up a fairly good show, for on a turnover of nearly 8,000 tons cash was up by £1 7s. 6d. at £67 7s. 6d., while three months gained 22s. 6d. at £68 12s. 6d. Stocks rose by 250 tons to 11,932 tons. In zinc, cash lost 5s. at £83 10s. 0d., while three months declined by 7s. 6d. to £83 10s. 0d. also, so that the market closed level. The turnover was 5,500 tons. Warehouse stocks rose by 648 tons to 5,076 tons.

Birmingham

Trade in the Midland area has shown steady expansion during the last four months. This is confirmed by the continuing decline of unemployment. It reached a peak of 45,170 in January and has now fallen to 29,081. The percentage is 1·3 compared with a national average of 1·5. The number of Midland workers on short-time, nearly all engaged in the motor industry, has dropped to 12,000, whereas at the peak of the recession in January it was 75,000. Over the last month, vacancies have increased. There are numerous unfilled jobs in the metal industries, particularly for skilled and semi-skilled men.

Although there has been considerable improvement in activity at iron foundries, no difficulty has been encountered in obtaining supplies of pig iron. Revival in the motor trade has been an important factor in stimulating demand for castings, but there has also been greater activity in general engineering and in the manufacture of components for heavy electrical equipment. The expansion in orders for steel sheets has continued. Steel mills rolling structural products such as joists and sections are well situated for work during the current quarter.

New York

Copper futures, after an early modest decline, steadied on covering. Dealings were light. Scrap copper advanced by another ¼ cent per lb. to 25¼ cents. This put a further squeeze on the customs smelter price for electrolytic copper. However, traders noted that custom smelters were wary about raising their quoted price since they were not sure that producers would follow. Meanwhile, custom smelters are selling in the domestic sector at an average price basis. The export copper market was relatively quiet, as were tin, lead and zinc.

While there are ample stocks of new copper, supplies of many scrap grades are difficult to acquire, Mr. Milton I. Schwab, of the Franklin Smelting and Refining Company, declared last week. Addressing a meeting of the Philadelphia Metals Association, Mr. Schwab attributed the scrap shortages to exports to Japan. In order to ensure that they can take full advantage of the American scrap copper supply, Mr. Schwab said, and notwithstanding their supply of cheap labour, the Japanese were able to convince their Government to create an internal copper price 5¼ cents a lb. above the world price. "What this really amounts to is a Government subsidy", he said.

Mr. Schwab added that it was too much to expect the Japanese to voluntarily restrict their U.S. scrap copper purchases. On the other hand, if domestic dealers and smelters protested loudly enough, U.S. Government officials may be awakened to this attack on the U.S. economy and attempt to persuade the Japanese Government to discontinue its policy of permitting an internal price so much higher than the world price, Mr. Schwab concluded.

Italy

The new aluminium plant to be built in Italy by the Montecantini Company will have a capacity of 100,000 tons of aluminium per annum, it was announced last week by Dr. Carlo Faina, the company's chairman and managing director. The original announcement that the company was planning to build a new aluminium plant was made last year, but no details were available at the time. Dr. Faina said the envisaged capacity of the plant was 20,000 tons higher than Italy's present annual aluminium output. He said the plant would be located in one of Italy's underdeveloped areas, probably Sardinia.

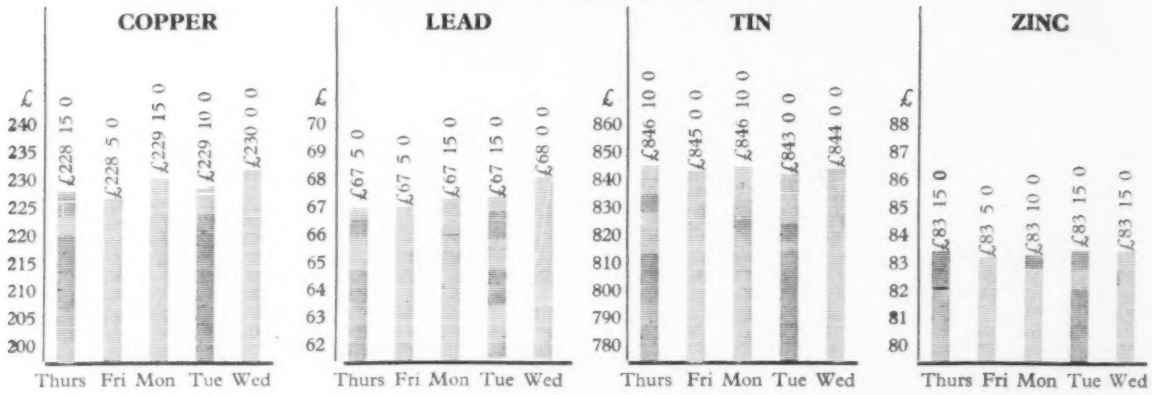
Japan

The Japanese Ministry of Trade has announced that foreign exchange worth 16,750,000 U.S. dollars would be allocated for imports of electrolytic copper, copper-based alloys, scrap copper and scrap copper-based alloys. Trade quarters estimate that about 25,000 tons of these metals will be importable with this allocation of exchange. The allocation would be made from funds reserved for the import of a total of 37,800 tons of these goods under the import budget for the April/September period, the Ministry said.

Non-Ferrous Metal Prices

London Metal Exchange

Thursday 20 April to Wednesday 26 April 1961



Primary Metals

All prices quoted are those available at 2 p.m. 26/4/61

		£	s.	d.
Aluminium Ingots	ton	186	0	0
Antimony 99·6%	„	237	10	0
Antimony Metal 99%	„	230	0	0
Antimony Oxide Commercial	„	194	10	0
Antimony White Oxide	„	212	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		11	0
Calcium	„	2	0	0
Cerium 99%	„	15	0	0
Chromium	„		6	11
Cobalt	„		12	0
Columbite per unit			8	10
Copper H.C. Electro	ton	230	0	0
Fire Refined 99·70%	„	229	0	0
Fire Refined 99·50%	„	228	0	0

		£	s.	d.
Copper Sulphate	ton	77	0	0
Germanium	grm.		—	
Gold	oz.	12	11	0½
Indium	„		10	0
Iridium	„	24	0	0
Lanthanum	grm.		15	0
Lead English	ton	68	0	0
Magnesium Ingots	lb.			
99·8%	„		2	2½
99·9+%	„		2	3
Notched Bar	„		2	9½
Powder Grade 4	„		5	6
Alloy Ingot, AZ91X		1	11½-2	1¼
Manganese Metal	ton	280	0	0
Mercury	flask	67	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.	20	0	0
Osmiridium	„		—	

		£	s.	d.
Palladium	oz.	9	0	0
Platinum	„	30	5	0
Rhodium	„	46	0	0
Ruthenium	„	16	0	0
Selenium	lb.	2	6	6
Silicon 98%	ton	123	0	0
Silver Spot Bars	oz.		6	7⅜
Tellurium Sticks	lb.	2	0	0
Tin	ton	844	0	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	83	13	9
Dust 95/97%	„	125	0	0
Dust 98/99%	„	131	0	0
Granulated 99+%	„	108	13	9
Granulated 99·99+%	„	123	13	9

**Duty and Carriage to customers' works for buyers' account.*

Foreign Quotations

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg≏£/ton	**Canada** c/lb≏£/ton	**France** fr/kg≏£/ton	**Italy** lire/kg≏£/ton	**Switzerland** fr/kg≏£/ton	**United States** c/lb≏£/ton
Aluminium		26.00 210 12	2.43 179 11	370 216 1	2.50 210 5	26.00 207 4
Antimony 99.0			2.55 188 8	520 303 13		32.50 259 0
Cadmium			15.75 1,069 0			160.00 1,275 4
Copper						
Crude						
Wire bars 99.9				440 256 19		
Electrolytic	31.75 232 1	27.50 222 15	3.20 236 9		2.75 231 5	29.00 231 6
Lead		10.00 81 0	.96 70 18	165 97 7	.78 65 11	11.00 87 13
Magnesium						
Nickel		70.00 567 0	9.00 665 2	1,180 689 2	7.50 630 15	74.00 589 15
Tin	117.25 856 19		11.88 878 18	1,590 928 11	9.65 811 11	108.50 864 14
Zinc						
Prime western		12.25 100 4 0				
High grade 99.95		12.85 104 17 0				
High grade 99.99		13.25 107 6 0			1.10 92 10	
Thermic			1.23 90 17			
Electrolytic			1.31 96 16	189 110 7		13.00 104 0

Non-Ferrous Metal Prices (continued)

Ingot Metals

All prices quoted are those available at 2 p.m. 26/4/61

	£	s.	d.
Aluminium Alloy (Virgin)			
B.S. 1490 L.M.5 .... ton	210	0	0
B.S. 1490 L.M.6 .... „	202	0	0
B.S. 1490 L.M.7 .... „	216	0	0
B.S. 1490 L.M.8 .... „	203	0	0
B.S. 1490 L.M.9 .... „	203	0	0
B.S. 1490 L.M.10 .... „	221	0	0
B.S. 1490 L.M.11 .... „	215	0	0
B.S. 1490 L.M.12 .... „	223	0	0
B.S. 1490 L.M.13 .... „	216	0	0
B.S. 1490 L.M.14 .... „	224	0	0
B.S. 1490 L.M.15 .... „	210	0	0
B.S. 1490 L.M.16 .... „	206	0	0
B.S. 1490 L.M.18 .... „	203	0	0
B.S. 1490 L.M.22 .... „	210	0	0
Aluminium Alloys (Secondary)			
B.S. 1490 L.M.1 .... ton	171	0	0
B.S. 1490 L.M.2 .... „	174	0	0
B.S. 1490 L.M.4 .... „	180	0	0
B.S. 1490 L.M.6 .... „	181	0	0
***Aluminium Bronze**			
BSS 1400 AB.1 ..... ton	247	0	0
BSS 1400 AB.2 ..... „	255	0	0

	£	s.	d.
***Brass**			
BSS 1400-B3 65/35 .. ton	179	0	0
BSS 249 ..... „		—	
BSS 1400-B6 85/15 .. „	227	0	0
***Gunmetal**			
R.C.H. 3/4% ton .... „		—	
(85/5/5/5) LG2 ..... „	223	0	0
(86/7/5/2) LG3 ..... „	232	0	0
(88/10/2/1) ..... „	286	0	0
(88/10/2/½) ..... „	296	0	0
***Manganese Bronze**			
BSS 1400 HTB1 ..... „	197	0	0
BSS 1400 HTB2 ..... „	214	0	0
BSS 1400 HTB3 ..... „	232	0	0
Nickel Silver			
Casting Quality 12% „	245	0	0
„ „ 16% „	260	0	0
„ „ 18% „	300	0	0
***Phosphor Bronze**			
B.S.1400P.B.1.(A.I.D. released) ..... „	313	0	0
B.S. 1400 L.P.B.1 „	244	0	0

**Average prices for the last week-end.*

	£	s.	d.
Phosphor Copper			
10% ..... ton	256	0	0
15% ..... „	258	0	0
Phosphor Tin			
5% ..... „	919	0	0
Silicon Bronze			
BSS 1400-SB1 ..... „	290	0	0
Solder, soft, BSS 219			
Grade C Tinmans ... „	386	10	0
Grade D Plumbers .. „	309	0	0
Grade M ..... „	425	3	0
Solder, Brazing, BSS 1845			
Type 8 (Granulated) lb.		—	
Type 9 „ „		—	
Zinc Alloys			
BSS 1004 Alloy A .. ton	117	3	9
BSS 1004 Alloy B.... „	121	3	9
Sodium-Zinc ..... lb.		2	7

Semi-Fabricated Products

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium			
Sheet 10 S.W.G. lb.	2	10½	
Sheet 18 S.W.G. „	3	0½	
Sheet 24 S.W.G. „	3	3½	
Strip 10 S.W.G. „	2	10½	
Strip 18 S.W.G. „	2	11½	
Strip 24 S.W.G. „	3	1	
Circles 22 S.W.G. „	3	4½	
Circles 18 S.W.G. „	3	3½	
Circles 12 S.W.G. „	3	2½	
Plate as rolled ..... „	2	10	
Sections ..... „	3	4	
Wire 10 S.W.G. .... „	3	1½	
Tubes 1 in o.d. 16 S.W.G. ..... „	4	4	
Aluminium Alloys			
BS1470. HS19W.			
Sheet 10 S.W.G. „	3	3	
Sheet 18 S.W.G. „	3	5½	
Sheet 24 S.W.G. „	4	1	
Strip 10 S.W.G. „	3	3	
Strip 18 S.W.G. „	3	4½	
Strip 24 S.W.G. „	4	0½	
BS1477. HP30M.			
Plate as rolled ..... „	3	1	
BS1470. HC15WP.			
Sheet 10 S.W.G. „	4	3	
Sheet 18 S.W.G. „	4	8½	
Sheet 24 S.W.G. „	5	8½	
Strip 10 S.W.G. „	4	4	
Strip 18 S.W.G. „	4	8½	
Strip 24 S.W.G. „	5	4½	
BS1477. HPC15WP.			
Plate heat treated ... „	3	10½	
BS1475. HG19W.			
Wire 10 S.W.G. „	4	2	
BS1471. HT19WP.			
Tubes 1 in. o.d. 16 S.W.G. ..... „	5	5	
BS1476. HE19WP.			
Sections ..... „	3	4	
Split tube			
19 S.W.G. (⅛") ..... „	4	2	
20 S.W.G. (⅛") ..... „	3	11	
21 S.W.G. (⅛") ..... „	4	1	
22 S.W.G. (¼") ..... „	4	11	
Welded tube			
14 to 20 S.W.G. (sizes ½" to 1½") .... „	3/10½ to 5/8½		

Brass			
Tubes ..... lb.	1	10	
Brazed Tubes ..... „	3	2½	
Drawn Strip Sections „	3	2½	
Sheet ..... ton	200	0	0
Strip ..... „	200	0	0
Extruded Bar ..... lb.	2	0½	
Condenser Plate (Yellow Metal) ..... ton	188	0	0
Condenser Plate (Naval Brass) ..... „	200	0	0
Wire ..... lb.	2	8¼	
Beryllium Copper			
Strip ..... „	1	4	11
Rod ..... „	1	1	6
Wire ..... „	1	4	9
Copper			
Tubes ..... lb.	2	2½	
Sheet ..... ton	263	0	0
Strip ..... „	263	0	0
H.C. Wire ..... „	280	15	0
Cupro Nickel			
Tubes 70/30 ..... lb.	3	6¼	

Lead			
Pipes (London) ..... ton	107	0	0
Sheet (London) ..... „	104	15	0
Tellurium Lead ..... „	£6 extra		
Nickel Silver			
Sheet and Strip 10% .. lb.	3	10½	
Wire 10% ..... „	4	3½	
Phosphor Bronze			
Wire ..... „	4	1½	
Titanium (1,000 lb. lots)			
Billet 4½" to 18" dia..... lb.	47/-	48/-	
Rod ½" to 4" dia..... „	85/-	53/-	
Wire ·036"-232" dia..... „	159/-	99/-	
Strip ·001" to ·048"..... „	350/-	68/-	
Sheet 8'×2'. 20 gauge „	73/-		
Tube, representative average gauge ..... „	198/-		
Extrusions ..... „	90/-		
Zinc			
Sheet ..... ton	121	15	0
Strip ..... „	nom.		

Domestic and Foreign

Merchants' average buying prices delivered, per ton, 25/4/61.

	£
Aluminium	
New Cuttings	141
Old Rolled	114
Segregated Turnings	81
Brass	
Cuttings	163
Rod Ends	145
Heavy Yellow	139
Light	133
Rolled	152
Collected Scrap	138
Turnings	139
Copper	
Wire	209
Firebox, cut up	206
Heavy	204
Light	201
Cuttings	211
Turnings	185
Braziery	181

	£
Gunmetal	
Gear Wheels	205
Admiralty	205
Commercial	190
Turnings	185
Lead	
Scrap	57
Nickel	
Cuttings	—
Anodes	555
Phosphor Bronze	
Scrap	190
Turnings	185
Zinc	
Remelted	76
Cuttings	66
Old Zinc	46

Metal Statistics

Detailed figures of the consumption and output of non-ferrous metals for the month of February, 1961 have been issued by the British Bureau of Non-Ferrous Metal Statistics, as follows in long tons:—

COPPER	Gross Weight	Copper Content
Wire	23,086	21,174
Rods, bars and sections	15,772	10,364
Sheet, strip and plate	13,602	10,835
Tubes	7,771	7,223
Castings and miscellaneous	7,450	—
Sulphate	2,912	—
	68,681	55,946
Of which:		
Consumption of Virgin Copper		43,777
Consumption of Copper and Alloy Scrap (Copper Content)		12,169

LEAD	
Cables	7,879
Batteries	2,656
Battery Oxides	2,896
Tetra Ethyl Lead	2,282
Other Oxides and Compounds	2,091
White Lead	689
Shot	498
Sheet and Pipe	5,797
Foil and Collapsible Tubes	325
Other Rolled and Extruded	677
Solder	1,261
Alloys	1,721
Miscellaneous Uses	1,658
Total	30,430

TIN	
Tinplate	761
Tinning:	
Copper Wire	51
Steel Wire	8
All other	71
Solder	169
Alloys	528
Foil and Collapsible Tubes, etc.	48
Tin Compounds, Salts, and Miscellaneous Uses	124
Total Consumption	1,760

ZINC	
Galvanising	7,992
Brass	9,860
Rolled Zinc	2,391
Zinc Oxide	2,046
Zinc Die-casting alloy	3,868
Zinc Dust	1,115
Miscellaneous Uses	846
Total, All Trades	28,118
Of which:	
High purity 99·99 per cent	4,437
Electrolytic and high grade 99·95 per cent	5,128
Prime Western, G.O.B. and debased	11,764
Remelted	508
Scrap Brass and other Cu alloys	3,552
Scrap Zinc, alloys and residues	2,467

ANTIMONY	
Batteries	154
Other Antimonial Lead	46
Bearings	23
Oxides—for White Pigments	93
Oxides—other	88
Miscellaneous Uses	14
Sulphides	7
Total Consumption	425
Antimony in scrap	
For Antimonial Lead	488
For Other Uses	73
Total Consumption	561

CADMIUM	
Plating Anodes	47·65
Plating Salts	6·60
Alloys: Cadmium Copper	6·25
Alloys: Other	4·00
Batteries: Alkaline	7·15
Batteries: Dry	0·50
Solder	5·55
Colours	21·85
Miscellaneous Uses	0·95
Total Consumption	100·50

Scrap Metal Prices

The figures in brackets give the English equivalents in £1 per ton:—

France (new francs per kilo):

Electrolytic copper scrap	(£219.9.0)	2.97
Heavy copper	(£219.9.0)	2.97
No. 1 copper wire	(£205.8.0)	2.78
Brass rod ends	(£166.9.0)	2.25
Zinc castings	(£71.13.0)	0.97
Lead	(£66.10.0)	0.90
Aluminium	(£125.12.0)	1.70

Italy (lire per kilo):

Aluminium soft sheet clippings (new)	(£178.2.0)	305
Lead, soft, first quality	(£80.0.0)	137
Lead, battery plates	(£44.19.0)	77
Copper, first grade	(£219.0.0)	375
Bronze, commercial gunmetal	(£183.19.0)	315
Brass, heavy	(£152.17.0)	260
Brass, light	(£140.3.0)	240
Brass, bar turnings	(£152.17.0)	260
Old zinc	(£64.4.0)	110

Japan (Yen per metric ton):

Electrolytic copper	(£—)	285,000
Copper wire No. 1	(£—)	265,000
Copper wire No. 2	(£—)	250,000
Heavy copper	(£—)	250,000
Light copper	(£—)	215,000
Brass, new cuttings	(£—)	200,000
Red brass scrap	(£—)	215,000

West Germany (D-marks per 100 kilos):

Used copper wire	(£204.19.0)	225
Heavy copper	(£204.19.0)	225
Light copper	(£182.4.0)	200
Heavy brass	(£132.1.0)	145
Light brass	(£95.13.0)	105
Soft lead scrap	(£52.16.0)	58
Zinc scrap	(£52.16.0)	58
Used aluminium unsorted	(£81.19.0)	90

Financial News

Harrison (Birmingham) Ltd.

Group net profit for 1960, £160,046 (£180,650) and distribution 6d. per 5s. share (same equivalent). Fixed assets £839,889 (£645,940), current assets £1,506,874 (£1,526,443) and liabilities, etc., £557,917 (£142,295).

Manganese Bronze and Brass Co. Ltd.

A final dividend of 8d. is being paid, making an unchanged 1s. 0½d. per share for 1960. A group profit for 1960 of £329,025 (after tax) compares with £344,128.

Anti-Attrition Metal Co.

Group net profit, 1960, £21,159 (loss £92,033). Fixed assets £472,032 (£457,900), current assets £551,572 (£371,698), and liabilities £465,237 (£292,390) including £253,674 (£114,374) overdraft.

Evered and Co.

Group net profit, 1960, £200,214 (£175,987)—dividend 10 per cent (6⅔ per cent equivalent). In June 1959 there was a special anniversary distribution equal to 1⅓ per cent, not subject to tax, and in February 1960 a further distribution equivalent to 4⅛ per cent, not subject to tax, from sale of investment. Fixed assets £1,028,984 (£892,365), current assets £1,689,018 (£1,627,516), and liabilities £510,591 (£498,145). Commitments £51,300.

Bisichi Tin (Nigeria)

Profit, 1960, £142,879 (£131,255), subject to tax £54,787 (£57,000) and dividend 22½ per cent on increased capital (20 per cent). Trade investment £105,701 (nil), market value £159,067. Current assets £499,899 (£517,290), liabilities £273,813 (£230,963). Half of estimated production of columbite has been sold for delivery in 1962.

Rhodesian Trust

At an informal stockholders' meeting in New York, Sir Ronald L. Prain, the chairman of Rhodesian Selection Trust Limited and Roan Antelope Copper Mines Limited, told stockholders that at the end of March world supply of refined copper still exceeded demand by about 150,000 short tons per year. He said this was not very much when related to world production of refined copper, which amounted to about 4·5 million short tons, but, "as market people well know, it is the last ton of excess or shortage which determines the price trend."

Sir Ronald said that although the statistical position still reflected a condition of over-supply, political uncertainty over certain of the more important producing areas had contributed to the support which the market experienced during the first three months of the year. While the political uncertainty was still a supporting factor, he noted, "there is now coming into the foreground of the picture the forces created by the continuing excellent demand outside the United States and the improvement in the situation in the United States itself".

Elektrokemisk A.S.

In its annual report, Elektrokemisk A.S. of Oslo, designers and suppliers of electric smelting furnaces and producers of ferro alloys, pyrites and aluminium, made a net profit before taxes of 22·2 million crowns in 1960, against 19·9 million in 1959.

THE STOCK EXCHANGE

With The Start Of A New Account The Undertone Remained Firm

ISSUED CAPITAL *	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 24 APRIL	+RISE—FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1961 HIGH	1961 LOW	1960 HIGH	1960 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation	33/-	+6d.	11	9	6 13 3	33/-	26/3	35/-	26/6
400,000	2/-	Anti-Attrition Metal	1/-		NIL	4	NIL	1/-	0/9	1/6	0/9
43,133,593	Stk. (£1)	Associated Electrical Industries	44/-	—3/9	15	15	6 16 3	54/10½	40/3	67/3	38/3
3,895,963	1	Birfield	66/6	+4/-	10	15‡	3 0 0	66/6	45/-	51/3	29/-
4,795,000	1	Birmid Industries	99/6	+2/-	20	20D	4 0 6	99/6	71/3	74/9	56/-
8,445,516	Stk. (10/-)	Birmingham Small Arms	35/6	—6d.	17½QT	12½	3 5 9	36/10½	24/9	30/6	18/3
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	14/-	—3d.	5	5	7 2 9	14/4½	13/9	17/4½	14/9
476,420	Stk. (£1)	Ditto Cum. B. Pref. 6%	16/9		6	6	7 3 3	17/6	16/9	20/-	17/1½
500,000	1	Bolton (Thos.) & Sons	48/9		12½	10	4 6 6	50/-	37/6	43/-	36/-
300,000	1	Ditto Pref. 5%	14/-		5	5	7 2 9	14/6	13/9	16/-	14/3
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6%	17/-		6	6	7 1 3	18/-	16/6	21/1½	17/7½
18,846,647	Stk. (£1)	British Insulated Callender's Cables	60/-	+4/6	13½	13½	4 10 0	60/-	50/4½	61/4½	47/-
20,456,599	5/-	British Oxygen Co. Ltd., Ord.	35/3	+1/3	16	16	2 5 6	35/3	26/3	35/-	19/10½
1,200,000	Stk. (5/-)	Canning (W.) & Co.	17/6xd	—2/6	15½	25 + *2½C‡	4 10 6	20/9	13/7½	19/9	13/7½
60,484	1/-	Carr (Chas.)	1/4½		NIL	12½	—	1/7½	1/-	2/3	1/-
555,000	1	Clifford (Chas.) Ltd.	28/6	+6d.	12	10	8 8 6	29/-	26/-	35/-	28/9
45,000	1	Ditto Cum. Pref. 6%	15/3		6	6	7 17 6	15/3	15/1½	16/-	15/10½
300,000	2/-	Coley Metals	4/3		15	15	7 1 3	4/2½	3/6	5/-	3/4½
10,185,696	1	Cons. Zinc Corp.†	77/-		20	15	5 4 0	77/-	64/-	80/9	59/6
5,399,056	1	Davy-Ashmore	170/-	—2/6	30‡	20	1 15 3	177/6	129/6	147/3	99/6
8,000,000	5/-	Delta Metal	24/6		20	17½	4 1 9	25/4½	19/9	28/3	18/6
5,296,550	Stk. (£1)	Enfield Rolling Mills Ltd.	46/-	+9d.	15	15	6 10 6	52/3	45/-	56/9	45/-
1,155,000	1	Evered & Co.	45/-		10B	10φ	2 19 6	45/-	42/6	42/9	29/3
18,000,000	Stk. (£1)	General Electric Co.	36/6xd	—9d.	10	10	5 9 6	39/6	29/6	47/9	29/-
1,500,000	Stk. (10/-)	General Refractories Ltd.	65/-	+3/9	25	20	3 17 0	65/-	42/9	52/6	40/-
937,500	5/-	Glacier Metal Co. Ltd.	20/9	+1/9	13	11½	3 2 9	21/1½	13/9	16/1½	11/1½
2,500,000	5/-	Glynwed Tubes	28/-xrtsxd—4½d.		22½	25¶	4 0 6	30/-	23/7½	27/6	17/-
7,228,065	10/-	Goodlass Wall & Lead Industries	44/3	+9d.	19L	16	3 6 9	44/9	34/9	41/9	33/-
696,780	10/-	Greenwood & Batley	25/-xcap	—1/-	30W	30	6 0 0	27/-	23/9Z	33/6	29/1½
792,000	5/-	Harrison (B'ham) Ord.	14/4½	+1/7½	*20‡	*17½	3 9 6	14/4½	12/-	15/10½	11/9
150,000	1	Ditto Cum. Pref. 7%	20/-		7	7	7 0 0	20/3	20/-	23/6	22/-
1,612,750	5/-	Heenan Group	15/6	6d.	13	15	4 4 0	15/7½	10/6	13/-	9/10½
251,689,407	Stk. (£1)	Imperial Chemical Industries	75/-	+2/9	13½	11½	3 13 3	75/7½	63/1½	76/6	54/-
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	15/-		5	5	6 13 3	15/9	14/10½	18/-	15/4½
29,196,118	**	International Nickel	134	+2½	$1.60	$1.50	2 1 6	134/-	104	105	84½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	14/6		5	5	6 18 0	14/10½	14/-	16/6	14/6
6,000,000	1	Ditto Ord.	63/3		12	12D	3 16 0	64/3	59/6	67/6	44/9
600,000	10/-	Keith, Blackman	21/-		17½	17½E	8 6 9	21/6	18/3	32/6	17/6
320,000	4/-	London Aluminium	12/4½		12	10	3 17 6	12/6	8/6	12/6	7/10½
765,012	1	McKechnie Bros. Ord.	59/6	+6d.	17½F	15F	5 17 6	59/6	53/6	71/6	57/3
1,530,024	1	Ditto A. Ord.	59/-	+1/-	17½F	15F	5 18 9	59/-	53/3	69/3	55/-
1,108,268	5/-	Manganese Bronze & Brass	16/-	—1/3	20%	20%	6 10 0	18/6	14/-	18/6	13/4½
50,628	6/-	Ditto (7½% N.C. Pref.)	5/6		7½	7½	8 3 9	6/-	5/4½	6/6	5/9
26,361,444	Stk. (£1)	Metal Box	89/-	—6d.	12M	13B	2 8 0	93/6	68/3	84/3	61/-
415,760	Stk. (2/-)	Metal Traders	8/6		50	50	11 15 3	8/7½	6/9	10/5	7/1½
160,000	1	Mint (The) Birmingham	41/-	+6d.	12½	10	6 2 0	41/-	36/-	39/-	33/6
80,000	5	Ditto Pref. 6%	76/3		6	6	7 17 6	77/6	76/-	80/-	75/-
5,187,938	Stk. (£1)	Morgan Crucible A	68/3	+4/3	13	12	3 16 3	68/3	53/4½	63/-	47/6
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref.	15/6		5½	5½	7 2 0	17/-	15/3	18/9	15/9
3,850,000	Stk. (£1)	Murex	47/6	+1/-	22½J	15	5 2 9	47/6	39/9	45/-	35/3
585,000	5/-	Ratcliffs (Great Bridge) Ord.	16/-xd		10	10R	3 2 6	16/6	16/-	17/-	14/9
195,000	5/-	Ditto 8% Max. Ord.	5/-		8	—	8 0 0	5/-	4/10½	5/3	5/-
1,064,880	10/-	Sanderson Kayser	37/6		35‡	25	4 13 3	38/-	33/9	40/3	27/7½
3,400,500	Stk. (5/-)	Serck	17/3	+6d.	12½	17½GD	3 12 6	18/3	15/-	25/6	15/3
8,035,372	Stk. (£1)	Stone-Platt Industries	66/-		15	15	4 11 0	67/-	55/-	64/4½	52/3
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	15/6		5½	5½	7 2 0	15/9	15/-	18/7½	15/3
35,344,881	Stk. (£1)	Tube Investments Ord.	77/9	—3/9	14	20	3 12 0	85/6	72/3	140/3	63/10½
41,000,000	Stk. (£1)	Vickers	37/-xd	+5/-	10	10	5 8 0	37/1½	28/-	39/7½	27/1½
750,000	Stk. (£1)	Ditto Pref. 5%	14/6	+1/6	5	5	6 18 0	14/9	12/7½	17/6	13/3
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	20/6		*5	*5	7 5 0A	20/7½	19/9	24/6	20/1½
4,594,418	1	Ward (Thos. W.) Ord.	80/-	+2/-	13½	25	3 8 9	80/-	64/6	94/-	63/-
7,109,424	Stk. (£1)	Westinghouse Brake	42/3	+6d.	11	10	5 4 0	42/3	36/4½	60/6	37/6
323,773	2/-	Wolverhampton Die-Casting	11/6	+9d.	35	30	6 1 9	11/6	9/-	13/10½	8/1½
591,000	5/-	Wolverhampton Metal	29/6		32½	27½	5 12 0	30/-	24/6	39/9	23/9
156,930	2/6	Wright, Bindley & Gell	4/6		15	20‡	8 6 9	4/6	3/7½	4/6	2/10½
124,140	1	Ditto Cum. Pref. 6%	13/6		6	6	8 17 9	13/7½	13/6	15/-	13/6
150,000	1/-	Zinc Alloy Rust Proof	5/3		40	30	7 12 6	5/3	4/6	5/4½	4/-

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡ and 100% capitalized issue. ⊕The figures given relate to the issue quoted in the third column. A Calculated on £7 8 9 gross. D and 50% capitalized issue. C paid out of Capital Profits. E and 50% capitalized issue in 7% 2nd Pref. Shares. R and 33⅓% capitalized issue in 8% Maximum Ordinary 5/- Stock Units. φ and 6¼% from Capital Profits B and 50% capitalized issue. G and 1½d. special distribution. F and special 5% tax free dividend. H As forecast. ¶And 3 for 7 capitalized issue. L and 33⅓% capitalized issue. M and 10% capitalized issue. J and 75% capitalized issue. S and 40% capitalized issue. O calculated at 13¾%. Interim on smaller capital P Calculated at 11½%. Q also 1/- special tax free dividend and 50% capitalized issue. T Per £1 unit. W Before capital reorganization. Calculated at 15%. Z After capital reorganization

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THE STOCK EXCHANGE

With The Start Of A New Account The Undertone Remained Firm

ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 24 APRIL +RISE—FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1961 HIGH	1961 LOW	1960 HIGH	1960 LOW
£	£			Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	33/– +6d.	11	9	6 13 3	33/–	26/3	35/–	26/6
400,000	2/–	Anti-Attrition Metal	1/–	NIL	4	NIL	1/–	0/9	1/6	0/9
43,133,593	Stk. (£1)	Associated Electrical Industries ...	44/– —3/9	15	15	6 16 3	54/10½	40/3	67/3	38/3
3,895,963	1	Birfield	66/6 +4/–	10	15‡	3 0 0	66/6	45/–	51/3	29/–
4,795,000	1	Birmid Industries	99/6 +2/–	20	20D	4 0 6	99/6	71/3	74/9	56/–
8,445,516	Stk. (10/–)	Birmingham Small Arms	35/6 —6d.	17½QT	12½	3 5 9	36/10½	24/9	30/6	18/3
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	14/– —3d.	5	5	7 2 9	14/4½	13/9	17/4½	14/9
476,420	Stk. (£1)	Ditto Cum. B. Pref. 6%	16/9	6	6	7 3 3	17/6	16/9	20/–	17/1½
500,000	1	Bolton (Thos.) & Sons	48/9	12½	10	4 6 6	50/–	37/6	43/–	36/–
300,000	1	Ditto Pref. 5%	14/–	5	5	7 2 9	14/6	13/9	16/–	14/3
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6% ...	17/–	6	6	7 1 3	18/–	16/6	21/1½	17/7½
18,846,647	Stk. (£1)	British Insulated Callender's Cables	60/– +4/6	13½	13½	4 10 0	60/–	50/4½	61/4½	47/–
20,456,599	5/–	British Oxygen Co. Ltd., Ord. ...	35/3 +1/3	16	16	2 5 6	35/3	26/3	35/–	19/10½
1,200,000	Stk. (5/–)	Canning (W.) & Co.	17/6xd —2/6	15¾	25 + *2½C‡	4 10 6	20/9	13/7½	19/9	13/7½
50,484	1/–	Carr (Chas.)	1/4½	NIL	12½	—	1/7½	1/–	2/3	1/–
555,000	1	Clifford (Chas.) Ltd.	28/6 +6d.	12	10	8 8 6	29/–	26/–	35/–	28/9
45,000	1	Ditto Cum. Pref. 6%	15/3	6	6	7 17 6	15/3	15/1½	16/–	15/10½
300,000	2/–	Coley Metals	4/3	15	15	7 1 3	4/2½	3/6	5/–	3/4½
10,185,696	1	Cons. Zinc Corp.†	77/–	20	15	5 4 0	77/–	64/–	80/9	59/6
5,399,056	1	Davy-Ashmore	170/– —2/6	30‡	20	1 15 3	177/6	129/6	147/3	99/6
8,000,000	5/–	Delta Metal	24/6	20	17½	4 1 9	25/4½	19/9	28/3	18/6
5,296,550	Stk. (£1)	Enfield Rolling Mills Ltd.	46/– +9d.	15	15	6 10 6	52/3	45/–	56/9	45/–
1,155,000	1	Evered & Co	45/–	10B	10φ	2 19 6	45/–	42/6	42/9	29/3
18,000,000	Stk. (£1)	General Electric Co.	36/6xd —9d.	10	10	5 9 6	39/6	29/6	47/9	29/–
1,500,000	Stk. (10/–)	General Refractories Ltd.	65/– +3/9	25	20	3 17 0	65/–	42/9	52/6	40/–
937,500	5/–	Glacier Metal Co. Ltd.	20/9 +1/9	13	11½	3 2 9	21/1½	13/9	16/1½	11/1½
2,500,000	5/–	Glynwed Tubes	28/-xrtsxd—4½d.	22½	25¶	4 0 6	30/–	23/7½	27/6	17/–
7,228,065	10/–	Goodlass Wall & Lead Industries ...	44/3 +9d.	19L	16	3 6 9	44/9	34/9	41/9	33/–
696,780	10/–	Greenwood & Batley	25/–xcap —1/–	30W	30	6 0 0	27/–	23/9Z	33/6	29/1½
792,000	5/–	Harrison (B'ham) Ord.	14/4½ +1/7½	*20‡	*17½	3 9 6	14/4½	12/–	15/10½	11/9
150,000	1	Ditto Cum. Pref. 7%	20/–	7	7	7 0 0	20/3	20/–	23/6	22/–
1,612,750	5/–	Heenan Group	15/6 +6d.	13	15	4 4 0	15/7½	10/6	13/–	9/10½
251,689,407	Stk. (£1)	Imperial Chemical Industries ...	75/– +2/9	13½	11½	3 13 3	75/7½	63/1½	76/6	54/–
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	15/–	5	5	6 13 3	15/9	14/10½	18/–	15/4½
29,196,118	••	International Nickel	134 +2½	$1.60	$1.50	2 1 6	134/–	104	105	84½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	14/6	5	5	6 18 0	14/10½	14/–	16/6	14/6
6,000,000	1	Ditto Ord.	63/3	12	12D	3 16 0	64/3	59/6	67/6	44/9
600,000	10/–	Keith, Blackman	21/–	17½	17½E	8 6 9	21/6	18/3	32/6	17/6
320,000	4/–	London Aluminium	12/4½	12	10	3 17 6	12/6	8/6	12/6	7/10½
765,012	1	McKechnie Bros. Ord.	59/6 +6d.	17½F	15F	5 17 6	59/6	53/6	71/6	57/3
1,530,024	1	Ditto A. Ord.	59/– +1/–	17½F	15F	5 18 9	59/–	53/3	69/3	55/–
1,108,268	5/–	Manganese Bronze & Brass	16/– —1/3	20⅞	20⅞	6 10 0	18/6	14/–	18/6	13/4½
50,628	6/–	Ditto (7½% N.C. Pref.)	5/6	7½	7½	8 3 9	6/–	5/4½	6/6	5/9
26,361,444	Stk. (£1)	Metal Box	89/– —6d.	12M	13B	2 8 0	93/6	68/3	84/3	61/–
415,760	Stk. (2/–)	Metal Traders	8/6	50	50	11 15 3	8/7½	6/9	10/5	7/1½
160,000	1	Mint (The) Birmingham	41/– +6d.	12½	10	6 2 0	41/–	36/–	39/–	33/6
80,000	5	Ditto Pref. 6%	76/3	6	* 6	7 17 6	77/6	76/–	80/–	75/–
5,187,938	Stk. (£1)	Morgan Crucible A	68/3 +4/3	13	12	3 16 3	68/3	53/4½	63/–	47/6
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	15/6	5½	5½	7 2 0	17/–	15/3	18/9	15/9
3,850,000	Stk. (£1)	Murex	47/6 +1/–	22½J	15	5 2 9	47/6	39/9	45/–	35/3
585,000	5/–	Ratcliffs (Great Bridge) Ord. ...	16/–xd	10	10R	3 2 6	16/6	16/–	17/–	14/9
195,000	5/–	Ditto 8% Max. Ord.	5/–	8	—	8 0 0	5/–	4/10½	5/3	5/–
1,064,880	10/–	Sanderson Kayser	37/6	35‡	25	4 13 3	38/–	33/9	40/3	27/7½
3,400,500	Stk. (5/–)	Serck	17/3 +6d.	12½	17½GD	3 12 6	18/3	15/–	25/6	15/3
8,035,372	Stk. (£1)	Stone-Platt Industries	66/–	15	15	4 11 0	67/–	55/–	64/4½	52/3
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	15/6	5½	5½	7 2 0	15/9	15/–	18/7½	15/3
35,344,881	Stk. (£1)	Tube Investments Ord.	77/9 —3/9	14	20	3 12 0	85/6	72/3	140/3	63/10½
41,000,000	Stk. (£1)	Vickers	37/–xd +5/–	10	10	5 8 0	37/1½	28/–	39/7½	27/1½
750,000	Stk. (£1)	Ditto Pref. 5%	14/6 +1/6	5	5	6 18 0	14/9	12/7½	17/6	13/3
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	20/6	*5	*5	7 5 0A	20/7½	19/9	24/6	20/1½
4,594,418	1	Ward (Thos. W.) Ord.	80/– +2/–	13½	25	3 8 9	80/–	64/6	94/–	63/–
7,109,424	Stk. (£1)	Westinghouse Brake	42/3 +6d.	11	10	5 4 0	42/3	36/4½	60/6	37/6
323,773	2/–	Wolverhampton Die-Casting ...	11/6 +9d.	35	30	6 1 9	11/6	9/–	13/10½	8/1½
591,000	5/–	Wolverhampton Metal	29/6	32½	27½	5 12 0	30/–	24/6	39/9	23/9
156,930	2/6	Wright, Bindley & Gell	4/6	15	20‡	8 6 9	4/6	3/7½	4/6	2/10½
124,140	1	Ditto Cum. Pref. 6%	13/6	6	6	8 17 9	13/7½	13/6	15/–	13/6
150,000	1/–	Zinc Alloy Rust Proof	5/3	40	30	7 12 6	5/3	4/6	5/4½	4/–

•Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. ••Shares of no Par Value. ‡ and 100% capitalized issue. ⊕The figures given relate to the issue quoted in the third column. A Calculated on £7 8 9 gross. D and 50% capitalized issue. C paid out of Capital Profits. E and 50% capitalized issue in 7% 2nd Pref. Shares. R and 33⅓% capitalized issue in 8% Maximum Ordinary 5/– Stock Units. φ and 6¼% from Capital Profits B and 50% capitalized issue. G and 1¾d. special distribution. F and special 5% tax free dividend. H As forecast. ¶And 3 for 7 capitalized issue. L and 33⅓% capitalized issue. M and 10% capitalized issue. J and 75%capitalized issue. S and 40% capitalized issue. O calculated at 13¾%. Interim on smaller capital P Calculated at 11¼%. Q also 1/– special tax free dividend and 50% capitalized issue. T Per £1 unit. W Before capital reorganization. Calculated at 15%. Z After capital reorganization

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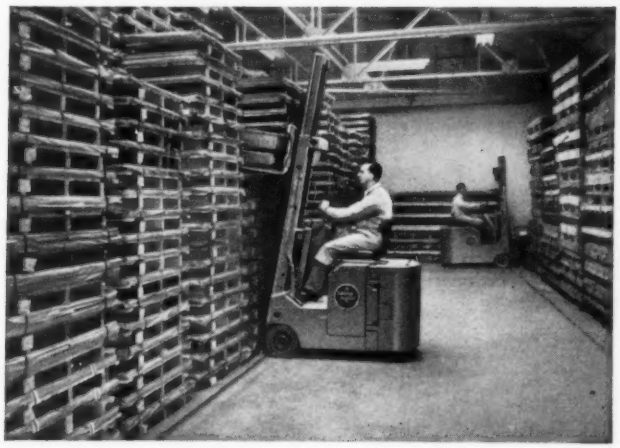

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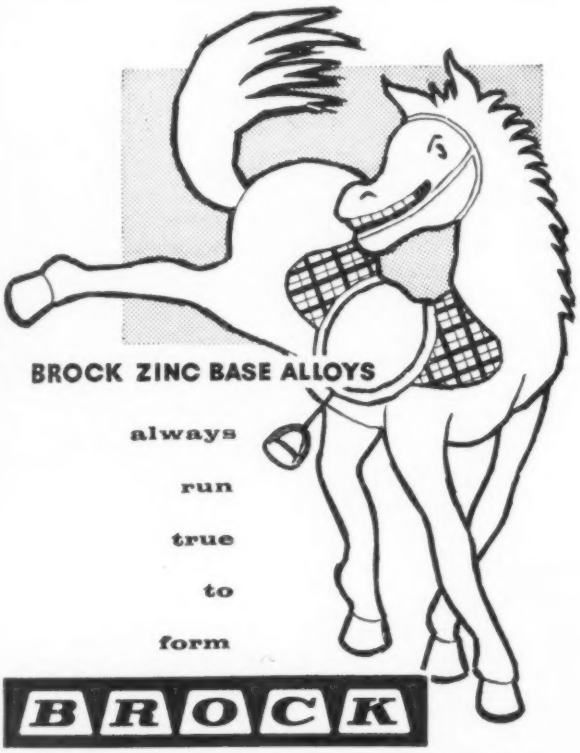

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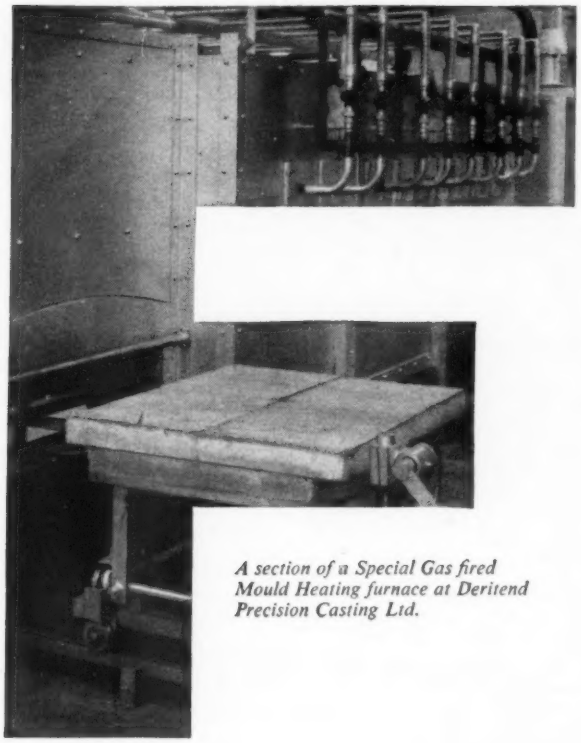

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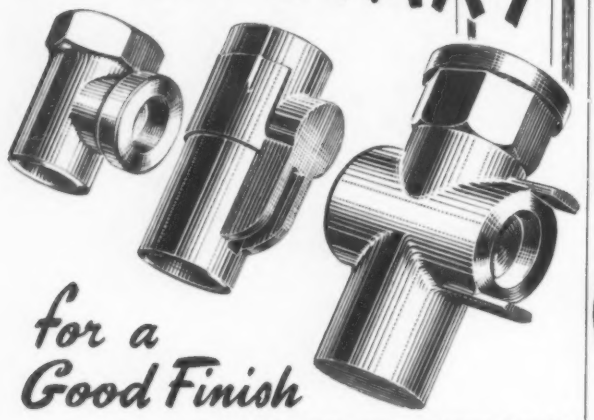

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